Appendix C

PERMIT TO INSTALL APPLICATION

The Ohio Gathering Company, L.L.C. > Barnesville, OH

Humphreys Compressor Station

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Project 123601.0044

Environmental solutions delivered uncommonly well

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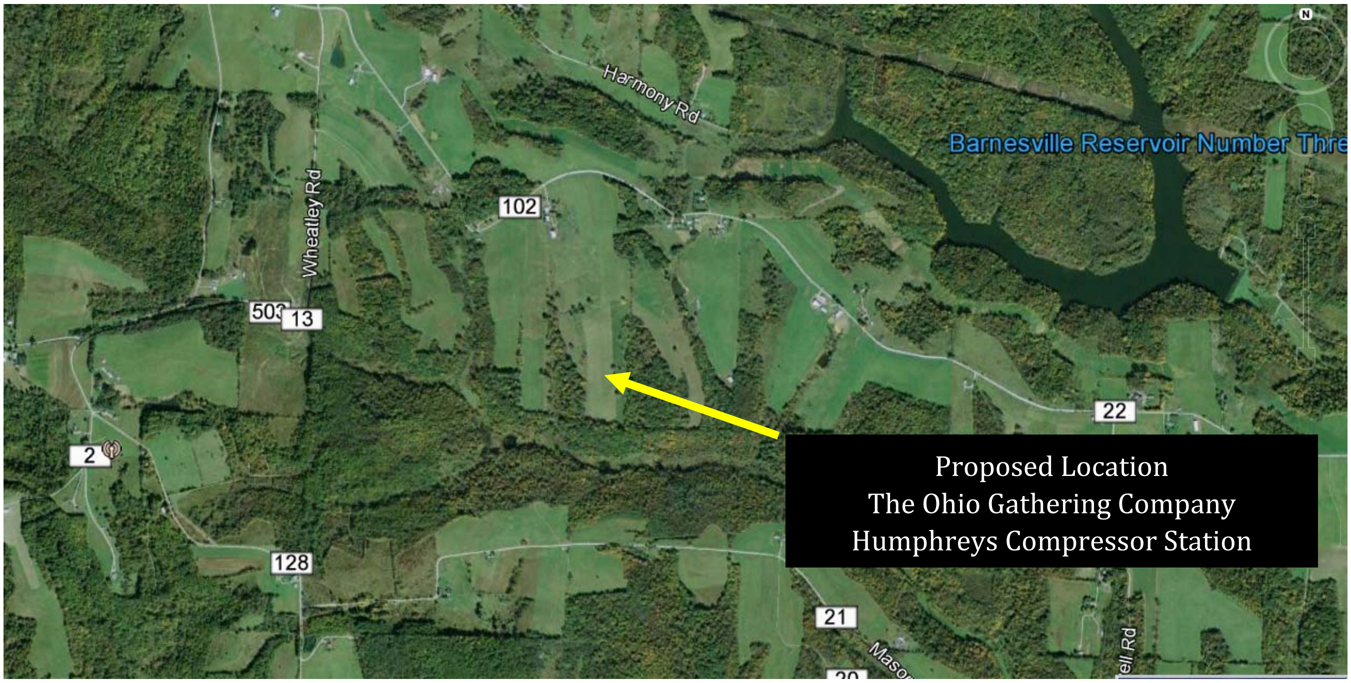
1. APPLICATION OVERVIEW

The Ohio Gathering Company, L.L.C. (Ohio Gathering Company) plans to construct a natural gas compressor station in Barnesville, Ohio (Humphreys Compressor Station) to gather and compress field gas mainly gathered from the Utica shale formation. The Humphreys Compressor Station will handle up to 240 million standard cubic feet per day (mmscfd) of field gas. With this Permit to Install (PTI) application, the Ohio Gathering Company is requesting approval for the construction and operation of this natural gas compressor station.

1.1. FACILITY LOCATION

The Humphreys Compressor Station will be located in Belmont County South of Johnson Ridge Rd in Barnesville, OH. Figure 1-1 is an area map that shows the site location relative to predominant geographical features such as highways and railroads.

Figure 1-1. Area Map for the Humphreys Compressor Station



1.2. OVERVIEW OF PROPOSED PROJECT

The Humphreys Compressor Station will handle 240 mmscfd of field gas produced from natural gas wells and transported to the station via pipelines. The field gas will enter the facility through an inlet separator (i.e., slug catcher), and a battery of natural gas-fired compressors will motivate gas flow through downstream pipelines. Additionally, two glycol-based dehydration units will reduce the moisture content of the field gas entering the compressor station.

The Ohio Gathering Company plans to install the following emission units during the construction of the Humphreys Compressor Station. Each of the following emission units is listed with the proposed Ohio EPA Emission Unit Identification Number (EUID). Refer to Figure 1-2 for a process flow diagram describing the organization of these emission units.

> Compressor Engines #1-6 (P001-P006) – Six (6) new natural gas-fired four-stroke lean burn (4SLB) internal combustion engines each rated at an operating capacity of 3,550 horsepower (hp) and each equipped with an oxidation catalyst.

> Dehydrator Regenerator Flares (P007-P008) – Two (2) flares that will be used to control emissions of off-gas from the glycol regeneration units. The flares will be equipped with natural gas pilot burners, and a small amount of natural gas will be used to purge the flare header to avoid flash back and resulting over-pressurization. Additional natural gas will be fired to supplement the heat content of gases sent to the flare, as necessary.

> Equipment Blowdowns (P009) – Process releases associated with periodic maintenance blowdown activities that will not pose a safety issue to plant personnel. This includes "light gas" releases and relatively small volume releases from equipment that are impractical to route to a flare.

> Equipment Leaks (P801) – Various equipment components, including valves, pumps, flanges, and connectors will be located throughout the plant that may result in fugitive emissions due to equipment leaks.

The Humphreys Compressor Station will also include the following *de minimis* sources under Ohio Administrative Code (OAC) 3745-15-05.

> Dehydrator Reboiler Heaters (B001-B002) – Two (2) natural gas-fired process heaters, each rated at a heat input capacity of 2.50 million British thermal units per hour (MMBtu/hr) supplying heat necessary to regenerate the glycol extraction streams;

> Unpaved Roadways (F001) – Unpaved roadways will be constructed in and around the plant resulting in fugitive particulate emissions from vehicle traffic;

> Methanol Tank (T006) – One (1) 500 gallon tank storing methanol used to dehydrate the process stream; and

> Truck Loading Operations (J001) – Material will be loaded into tanker trucks from storage tanks T001-T005, and displaced vapors will be routed back to the battery of storage tanks.

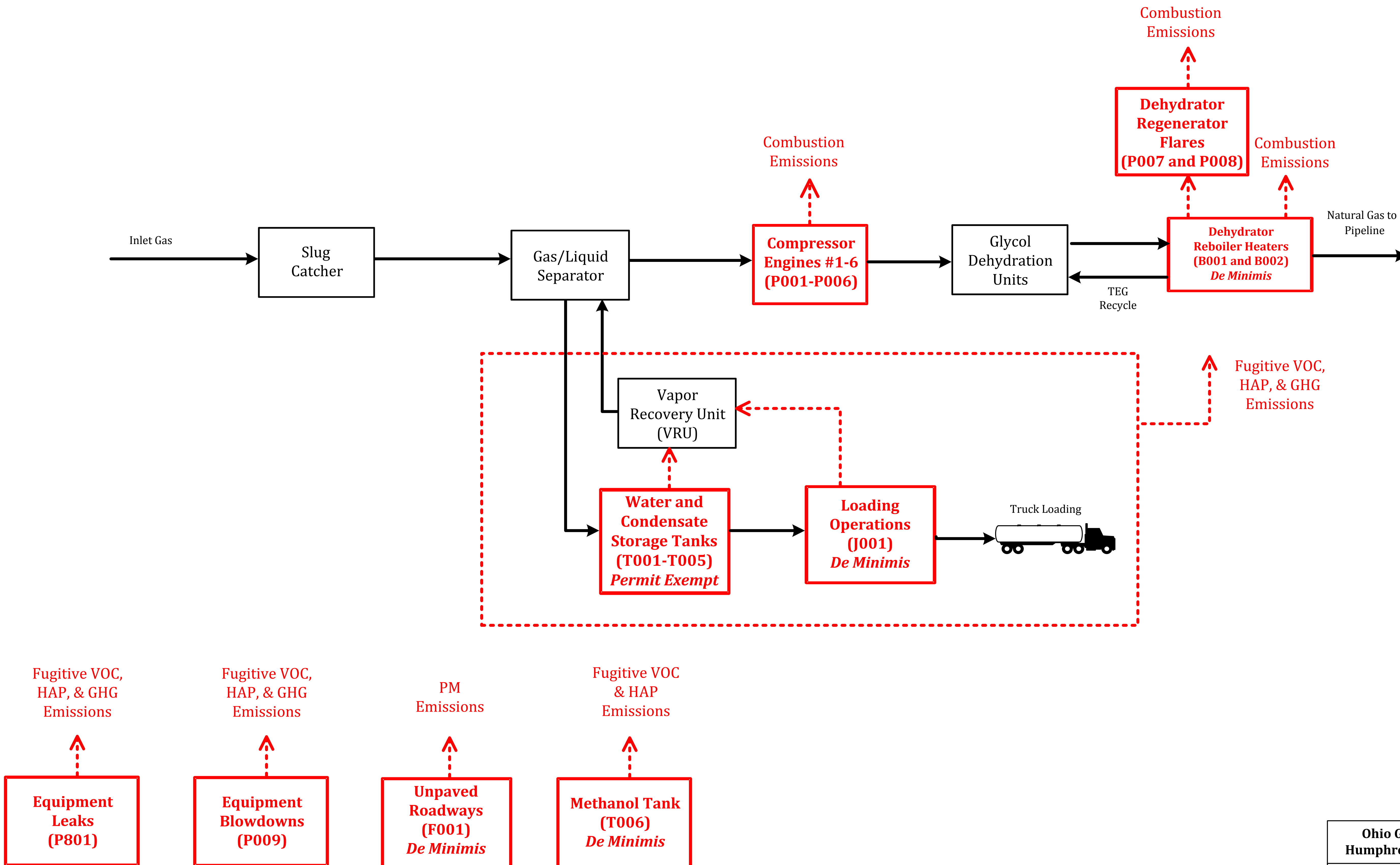
Additionally, The Humphreys Compressor Station will include the following emissions sources considered exempt from permitting under OAC 3745-31-03(A)(1).

- Storage Tanks (T001-T005) – A battery of five (5) 13,536 gallon liquid storage tanks. Vapors from the storage tank battery are routed to a closed vent system that is equipped with a mechanical vapor recovery unit (VRU). Each of these tanks will be equipped with submerged filling mechanisms and will be eligible for the permanent permitting exemption provided in OAC 3745-31-03(A)(1)(l)(iv).[1]

The Ohio Gathering Company requests that the PTI be issued for all non-exempt, non-*de minimis* emission units to be installed at the Humphreys Compressor Station.

[1] The recent amendments to 40 CFR 60, Subpart OOOO (NSPS OOOO) published on September 23, 2013, establish design and recordkeeping requirements for tanks that use a vapor recovery unit (VRU) to control tank emissions to levels below the applicability threshold of six (6) tons per year by routing displaced vapors back into process streams. Because the Ohio Gathering Company will comply with the design and recordkeeping requirements established in NSPS OOOO, and because each storage tank will not exhibit VOC emission rates exceeding six (6) tpy with the use of the VRU, these tanks are not considered affected facilities under NSPS OOOO. As such, T001-T005 qualify for the permit exemption provided in OAC 3745-31-03(A)(1)(l)(iv).

FIGURE 1-2. PROCESS FLOW DIAGRAM FOR THE HUMPHREYS COMPRESSOR STATION



Ohio Gathering Company – Humphreys Compressor Station
Process Flow Diagram
Trinity Consultants 123601.0044 April 2014

1.3. PROPOSED PROJECT EMISSIONS

Table 1-1 provides a summary of the potential annual emissions attributable to the installation of the Humphreys Compressor Station, including particulate matter, particulate matter with an aerodynamic diameter of less than 10 microns, and particulate matter with an aerodynamic diameter of less than 2.5 microns ($PM/PM_{10}/PM_{2.5}$); nitrogen oxides (NO_X); sulfur dioxide (SO_2); carbon monoxide (CO); volatile organic compounds (VOC); greenhouse gases (i.e., carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]) expressed as carbon dioxide equivalents (CO_2e); total hazardous air pollutants (HAP); and hexane, which is the highest single HAP emitted by the station. The detailed calculation documentation is provided in Appendix A.

Table 1-1. Potential Emissions for the Humphreys Compressor Station

EU ID	Emission Unit Description	Annual Emissions (tpy)									
		NO_X	CO	VOC	SO_2	PM	PM_{10}	$PM_{2.5}$	CO_2e[a]	Formaldehyde	Total HAP
P001	Compressor Engine #1	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P002	Compressor Engine #2	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P003	Compressor Engine #3	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P004	Compressor Engine #4	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P005	Compressor Engine #5	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P006	Compressor Engine #6	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P007	Dehydrator #1 Flare	2.10	11.35	0.96	0.02	0.23	0.23	0.23	1,986	8.89E-06	0.11
P008	Dehydrator #2 Flare	2.10	11.35	0.96	0.02	0.23	0.23	0.23	1,986	8.89E-06	0.11
P009	Equipment Blowdowns	-	-	0.58	-	-	-	-	209	-	0.04
P801	Fugitive Equipment Leaks	-	-	1.92	-	-	-	-	82	-	0.12
J001	Truck Loading Operations[b]	-	-	0.28	-	-	-	-	2.08	-	0.07
B001	Dehydrator #1 Reboiler[b]	1.07	0.90	0.06	0.01	0.08	0.08	0.08	1,410	8.05E-04	0.02
B002	Dehydrator #2 Reboiler[b]	1.07	0.90	0.06	0.01	0.08	0.08	0.08	1,410	8.05E-04	0.02
F001	Compressor Station Roadways[b]	-	-	-	-	0.28	0.07	0.007	-	-	-
T001	Storage Tank #1[c]	-	-	1.50	-	-	-	-	11	-	0.35
T002	Storage Tank #2[c]	-	-	1.50	-	-	-	-	11	-	0.35
T003	Storage Tank #3[c]	-	-	1.50	-	-	-	-	11	-	0.35
T004	Storage Tank #4[c]	-	-	1.50	-	-	-	-	11	-	0.35
T005	Storage Tank #5[c]	-	-	1.50	-	-	-	-	11	-	0.35
T006	Methanol Storage Tank[b]	-	-	0.03	-	-	-	-	-	-	--
Totals		109.18	63.59	44.74	0.46	7.93	7.71	7.65	89,436	6.17	11.79

a. Carbon dioxide equivalent (CO_2e) emissions. Represents the sum of carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) emissions adjusted by each pollutant's global warming potential as identified in 40 CFR 51.166(b)(48)(ii) and Table A-1 to 40 CFR 98, Subpart A.

b. These units are classified as a *de minimis* sources under Ohio Administrative Code (OAC) 3745-15-05.

c. These units are classified as permit exempt under Ohio Administrative Code (OAC) 3745-31-03(A)(1)(l)(iv).

This section presents information and data to either confirm non-applicability of or demonstrate compliance with potentially applicable federal and state air permitting and regulatory requirements.

2.1. FEDERAL PERMITTING APPLICABILITY

2.1.1. PSD & Nonattainment New Source Review (NANSR) Applicability

The applicability of PSD is evaluated for proposed construction, reconstruction, and modification projects that result in an emission increase of a regulated NSR pollutant for which the area is in attainment with the National Ambient Air Quality Standards (NAAQS). Belmont County has been designated “in attainment” or “unclassifiable” for all regulated NSR pollutants.[2] Natural gas compressor stations are not classified as one of the 28 listed source categories in OAC 3745-31-01(LLL)(2)(a), and are therefore subject to the general PSD major source threshold of 250 tpy provided in OAC 3745-31-01(LLL)(2)(b).

Additionally, the final PSD and Title V Greenhouse Gas (GHG) Tailoring Rule was published in the Federal Register on June 3, 2010 (75 FR 31514). Under this rule, GHGs can, as of July 1, 2011, become “subject to regulation” under the PSD program for new sources expected to emit more than 100,000 tpy CO_2e.

2.1.1.1. PSD Applicability

Table 1-1 in Section 1.0 of this application demonstrates that the potential emissions increases attributable to the proposed project for each of the NSR-regulated pollutants are all below the major source threshold of 250 tpy, and emissions of GHGs from the Humphreys Compressor Station will not exceed the “subject to regulation” threshold of 100,000 tpy CO_2e. Therefore, the Ohio Gathering Company is not subject to PSD review for the proposed construction of the Humphreys Compressor Station.

2.1.1.2. NANSR Applicability

The applicability of NANSR is evaluated for proposed construction, reconstruction, and modification projects that result in an emission increase of a regulated NSR pollutant for which the area is not attaining the NAAQS. Because Belmont County has been designated as “in attainment” or “unclassifiable” for all regulated NSR pollutants, NANSR does not apply to the proposed project.

2.1.2. Title V Operating Permit Program Applicability

The Title V operating permit program consolidates state and federal requirements applicable to major sources into a single comprehensive operating permit for the purposes of facilitating ongoing compliance. In accordance with OAC 3745-77, sources with a potential to emit (PTE) of 100 tpy or more for criteria pollutants, 25 tpy or more for total HAP, or 10 tpy or more for individual HAP are considered major sources for which applicants must obtain a Title V operating permit. As of July 1, 2011, newly constructed sources with potential GHG emissions of at least 100,000 tpy CO_2e will also be required to obtain Title V operating permits under U.S. EPA’s GHG Tailoring Rule. Table 1-1 in Section 1.0 of this application demonstrates that

[2] Attainment designations for Ohio counties are established in 40 CFR 81.336.

potential emissions of NO_X will exceed 100 tpy; therefore, the Ohio Gathering Company is required to obtain a Title V operating permit for the Humphreys Compressor Station. The Ohio Gathering Company will submit an application for a Title V operating permit within 12 months of commencing operation of the Humphreys Compressor Station.

2.2. NEW SOURCE PERFORMANCE STANDARDS

The federal New Source Performance Standards (NSPS) require new, modified, or reconstructed sources to control emissions to the level that is achievable by the best system of emissions reduction as specified in the provisions of the applicable rule. The following section of this report provides applicability determinations for each of the NSPS to which the Humphreys Compressor Station is potentially subject.

In addition to the specific standards described below, the Ohio Gathering Company must also comply with the general provisions of Title 40, Code of Federal Regulations, Part 60 (40 CFR 60), Subpart A, which establish notification, recordkeeping, testing, monitoring, and reporting requirements for any and all sources subject to a particular NSPS.

2.2.1. 40 CFR 60, Subpart JJJJ – Spark Ignition Internal Combustion Engines

Affected sources under 40 CFR 60, Subpart JJJJ (NSPS JJJJ), include stationary spark ignition (SI) internal combustion engines (ICE) that commence construction after June 12, 2006, and that were manufactured after July 1, 2007, for engines rated at a capacity greater than 500 hp.[3] Compressor Engines #1-6 (P001-P006) to be installed at the Humphreys Compressor Station will be subject to the requirements of NSPS JJJJ, as noted below.

In accordance with 40 CFR 60.4233(e), owners and operators of SI ICE rated at capacities greater than 100 hp must comply with the emission standards established in Table 1 to NSPS JJJJ for all pollutants. Rather than purchasing engines certified to comply with NSPS JJJJ, the Ohio Gathering Company will apply the following procedures described in 40 CFR 60.4243(b)(2)(ii) to demonstrate compliance with the applicable emissions standards of NSPS JJJJ.

- Develop a maintenance plan and retain records of all maintenance efforts;
- Maintain and operate each engine in a manner consistent with good air pollution control practices; and
- Conduct performance testing in accordance with the procedures established in 40 CFR 60.4244 upon startup and every three (3) years thereafter or upon completing every 8,760-hour operating period, whichever is sooner.

2.2.2. 40 CFR 60, Subpart Kb – Volatile Organic Liquid Storage Tanks

Affected sources under 40 CFR 60, Subpart Kb (NSPS Kb) include storage vessels with a capacity greater than or equal to 75 cubic meters (19,812.9 gallons) that are used to store volatile organic liquids for which construction, reconstruction, or modification is commenced after July 23, 1984. As described in Section 1.2,

[3]According to 40 CFR 60.4230(a), the date that construction commences is the date on which the owner or operator orders the engine.

the storage tanks (T001-T006) at the Humphreys Compressor Station are each sized to a capacity less than 75 cubic meters and are therefore not subject to the requirements of NSPS Kb.

2.2.3. 40 CFR 60, Subpart KKK – Equipment Leaks of VOC from Onshore Natural Gas Compressor Stations

On April 17, 2012, U.S. EPA finalized amendments to 40 CFR 60, Subpart KKK (NSPS KKK) alongside the finalized standards of 40 CFR 60, Subpart OOOO (NSPS OOOO) revising the applicability date under NSPS KKK to include only those sources constructed, reconstructed, or modified after January 20, 1984, and on or before August 23, 2011. Because the Humphreys Compressor Station will be constructed after August 23, 2011 (i.e., the proposal date of NSPS OOOO), the facility is subject to the requirements of NSPS OOOO rather than the standards of NSPS KKK.

2.2.4. 40 CFR 60, Subpart OOOO – Crude Oil and Natural Gas Production, Transmission, and Distribution

On September 23, 2013, U.S. EPA finalized the amendments to the Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution (NSPS OOOO). The requirements in this subpart replace the requirements in NSPS KKK for sources for which construction, reconstruction, or modification occurs after August 23, 2011. Because the Humphreys Compressor Station will include reciprocating compressors, pneumatic controllers, and storage vessels constructed after August 23, 2011, the Ohio Gathering Company must comply with the following standards for each of the affected facilities.

Reciprocating Compressors

In accordance with 40 CFR 60.5385(a), the Ohio Gathering Company must replace the reciprocating compressor rod packing prior to completing 26,000 hours of operation for each compressor or within 36 months from startup or the date of the most recent rod packing replacement. To facilitate compliance with this requirement, the Ohio Gathering Company must continuously record the number of hours of operation or the number of months since startup or since the most recent replacement of the compressor rod packing, whichever is later, as described in 40 CFR 60.5415(c)(1).

Pneumatic Controllers

The standards of 40 CFR 60.5390(c)(2) specify that the Ohio Gathering Company must label (i.e., tag) all pneumatic controllers at the Humphreys Compressor Station with the date of installation and additional identification information. Because the Ohio Gathering Company will install these pneumatic controllers after October 15, 2013, these devices must operate at a bleed rate of no greater than six (6) standard cubic feet per hour pursuant to 40 CFR 60.5390(c)(1).

Storage Vessels

The Ohio Gathering Company will install a mechanical VRU to route overhead vapors from the condensate storage tanks (T001-T005) into the inlet gas stream. Pursuant to 40 CFR 60.5365(e),

> *"Any vapor from the storage vessel that is recovered and routed to a process through a VRU designed and operated as specified in this section is not required to be included in the determination of VOC*

potential to emit for purposes of determining affected facility status, provided you comply with the requirements in paragraphs (e)(1) trough (4) of this section."

The Ohio Gathering Company will meet the cover and closed vent system requirements specified in 40 CFR 60.5411(b)-(c) and maintain records that document compliance with the cover and closed vent system requirements. As Table 1-1 demonstrates that each condensate storage tank will not exhibit VOC emission rates exceeding six (6) tpy with the use of the VRU, these tanks are not considered affected facilities under NSPS OOOO pursuant to 40 CFR 60.5365(e).

Fugitive Components

The standards of NSPS OOOO incorporate by reference with certain exceptions the leak detection and repair (LDAR) requirements of the Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemical Manufacturing Industry for which Construction, Reconstruction, or Modification Commenced after November 7, 2006 (NSPS VVa). Per 40 CFR 60.5365(f)(2), the LDAR requirements apply to equipment that is located at an onshore natural gas processing plant, which is defined by 40 CFR 60.5430 as,

"…any processing site engaged in the extraction of natural gas liquids from field gas, fractionation of mixed natural gas liquids to natural gas products, or both. A Joule-Thompson valve, a dew point depression valve, or an isolated or standalone Joule-Thompson skid is not a natural gas processing plant."

Additionally, natural gas liquids are defined as,

"…the hydrocarbons, such as ethane, propane, butane, and pentane that are extracted from field gas."

U.S. EPA has historically interpreted the term "extraction" as including only forced processes that removed natural gas liquids from field gas and not unforced processes such as gravity or natural condensation.[4] While the Humphreys Compressor Station will remove condensate from the raw natural gas, this process occurs incidentally within the cyclonic separators of the compressor engines through centrifugal separation. Because the facility does not extract natural gas liquids (as defined above), the compressor station does not meet the definition of a natural gas processing plant as stated above, and the equipment leak standards specified in NSPS OOOO are not applicable to the Humphreys Compressor Station.

2.2.5. 40 CFR 60, Subpart XX - Bulk Gasoline Terminals

Affected sources under 40 CFR 60, Subpart XX (NSPS XX) include all loading racks at bulk gasoline terminals delivering liquid product into gasoline tanker trucks. The Humphreys Compressor Station does not deliver "gasoline" as defined in 40 CFR 60.501, since the materials handled at the facility are naturally occurring (i.e., the materials are not petroleum distillates or a petroleum distillate/alcohol blend). Therefore, the provisions of this subpart are not applicable to the Humphreys Compressor Station.

[4] Equipment Leaks of VOC in Natural Gas Production Industry – Background Information for Promulgated Standards; EPA-450/3-82-024b.

2.3. NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

National Emission Standards for Hazardous Air Pollutants (NESHAPs), located in 40 CFR 63, are typically applicable to specific categories of sources that have the potential to emit HAP in levels greater than 10 tpy for any individual HAP or 25 tpy for any combination of HAP (i.e., major HAP sources). Emissions and operational limitations provided in the NESHAPs are established on the basis of a Maximum Achievable Control Technology (MACT) determination for a particular major source category.

Furthermore, generally available control technology (GACT)-based NESHAPs (located in 40 CFR 63) require area (i.e., non-major) sources to control emissions to the level achievable by the use of generally available control technologies or management practices to reduce emissions of HAP.

Because the Humphreys Compressor Station will emit total and individual HAP in quantities less than 25 and 10 tpy, respectively, the facility will be considered an area (i.e., non-major) source of HAP, and the following section of this report provides applicability determinations for each of the NESHAP standards to which the Humphreys Compressor Station is potentially subject.

In addition to the specific standards described below, the Ohio Gathering Company must also comply with the general provisions of 40 CFR 63, Subpart A, which establish notification, recordkeeping, testing, monitoring, and reporting requirements for any and all sources subject to a particular NESHAP standard.

2.3.1. 40 CFR 63, Subpart EEEE – Organic Liquids Distribution (Non-Gasoline)

Affected facilities under 40 CFR 63, Subpart EEEE (OLD MACT), include the collection of activities and equipment used to distribute organic liquids into, out of, or within a facility that is a major source of HAP as described in 40 CFR 63.2338(b). Because the Humphreys Compressor Station is not a major source of HAP, the Ohio Gathering Company is not subject to the standards of the OLD MACT.

2.3.2. 40 CFR 63, Subpart BBBBBB – Gasoline Distribution Bulk Terminals, Bulk Plants, and Pipeline Facilities

Affected sources under 40 CFR 63, Subpart BBBBBB (GACT 6B), include bulk gasoline terminals, pipeline breakout stations, pipeline pumping stations, and bulk gasoline plants that are area sources of HAP emissions. The Humphreys Compressor Station does not meet the definition of any of the regulated facilities primarily because the facility does not receive gasoline, as defined in 40 CFR 63.11100, by pipeline, ship, or barge. Therefore, the provisions of GACT 6B are not applicable to the Humphreys Compressor Station.

2.3.3. 40 CFR 63, Subpart HH – Oil and Natural Gas Production Facilities

On April 17, 2012, U.S. EPA announced issuance of amendments to 40 CFR 63, Subpart HH (MACT HH) along with the announced issuance of NSPS OOOO. Affected sources at area sources of HAP emissions under MACT HH include triethylene glycol (TEG) dehydration units as described in 40 CFR 63.760(b)(2). Because the Ohio Gathering Company will maintain records pursuant to 40 CFR 63.774(d)(1) documenting that actual average emissions of benzene from each TEG dehydration unit will be less than 0.9 megagrams per year, the TEG dehydration units will be exempt from the requirements of 40 CFR 63.764(d) as described in 40 CFR 63.764(e)(1)(ii).

2.3.4. 40 CFR 63, Subpart HHH – Natural Gas Transmission and Storage Facilities

Affected sources under 40 CFR 63, Subpart HHH (MACT HHH) include natural gas transmission and storage facilities that are major sources of HAP as provided in 40 CFR 63.1270(a). Because the Humphreys Compressor Station is not a major source of HAP, the Ohio Gathering Company is not subject to the standards of MACT HHH.

2.3.5. 40 CFR 63, Subpart R – Gasoline Distribution Facilities (Bulk Gasoline Terminals and Pipeline Breakout Stations)

Affected sources under 40 CFR 63, Subpart R (MACT R), include bulk gasoline terminals and pipeline breakout stations. The Humphreys Compressor Station does not meet the definition of any of the regulated facilities primarily because the facility does not receive gasoline, as defined in 40 CFR 60.501, by pipeline, ship, or barge. Therefore, the provisions of MACT R are not applicable to the Humphreys Compressor Station.

2.3.6. 40 CFR 63, Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines

According to 40 CFR 63.6590(a)(2)(iii), affected sources under 40 CFR 63, Subpart ZZZZ (MACT ZZZZ), include new stationary reciprocating internal combustion engines (RICE) installed at area sources after June 12, 2006; therefore, the gas-fired compressor engines (P001-P006) to be installed at the Humphreys Compressor Station will be subject to the standards of MACT ZZZZ. As described in 40 CFR 63.6590(c)(1), new RICE located at area sources must comply with MACT ZZZZ by complying with the applicable requirements of NSPS JJJJ for spark ignition engines, and no further requirements under MACT ZZZZ apply to such engines. As described in Sections 2.2.1, P001-P006 will comply with all applicable requirements under NSPS JJJJ.

2.4. RISK MANAGEMENT PROGRAM

Facilities operating with more than a threshold quantity of a regulated substance in a process, as defined in 40 CFR 68.3, must comply with the provisions of 40 CFR 68 including requirements to develop a risk management plan (RMP). As part of the proposed project, the Ohio Gathering Company will potentially store mixtures of ethane, propane, butane, isobutane, pentane, and isopentane in quantities greater than 10,000 pounds at the Humphreys Compressor Station.

However, in accordance with 40 CFR 68.115(b)(2)(iii),

> *Prior to entry into a natural gas processing plant or a petroleum refining process unit, regulated substances in naturally occurring hydrocarbon mixtures need not be considered when determining whether more than a threshold quantity is present at a stationary source. Naturally occurring hydrocarbon mixtures include any combination of the following: condensate, crude oil, field gas, and produced water, each as defined in 40 CFR 68.3*.

"Condensate" is defined in 40 CFR 68.3 as "hydrocarbon liquid separated from natural gas that condenses due to changes in temperature, pressure, or both, and remains liquid at standard conditions."

Because the hydrocarbon mixtures stored at the Humphreys Compressor Station will not have been processed in a natural gas processing plant (and are naturally occurring hydrocarbon mixtures), the proposed project does not trigger the applicability of 40 CFR 68 in accordance with the exemption provided in 40 CFR 68.115(b)(2)(iii).

2.5. STATE OF OHIO REGULATORY APPLICABILITY

2.5.1. OAC 3745-17-07 – Control of Visible Particulate Emissions from Stationary Sources

OAC 3745-17-07(A) limits visible particulate emissions from all stacks to less than 20 percent opacity, as a 6-minute average, except during periods of startup, shutdown, and malfunction. However, visible emissions may exceed 20 percent opacity, as a 6-minute average, but not for more than 6 consecutive minutes in any 1-hour period. Visible emissions may not exceed 60 percent opacity, as a 6-minute average, at any time. The exhaust stacks associated with the compressor engines (P001-P006) will be subject to this visible emissions standard.

2.5.2. OAC 3745-17-10 – Restrictions on Particulate Emissions from Fuel Burning Equipment

OAC 3745-17-10 applies to facilities in which fuel, including any product or by-product of a manufacturing process, is burned for the primary purpose of producing heat or power by indirect heat transfer. The combustion sources that are part of the proposed project include the following:

- The gas-fired compressor engines (P001-P006); and
- The Dehydrator Regenerator Flares (P007-P008).

None of these combustion sources will be to be subject to the requirements of this rule given that these sources do not produce heat or power by indirect heat transfer.

2.5.3. OAC 3745-17-11 – Restrictions of Particulate Emissions from Industrial Processes

The emission limits of OAC 3745-17-11 apply to any operation, process, or activity that releases or may release particulate emissions into the ambient air. As described in OAC 3745-17-11(B)(5)(b), particulate emissions from large (i.e., greater than 600 hp) stationary internal combustion engines are limited to 0.062 pounds per million British thermal units (lb/MMBtu) of heat input. Each of the gas-fired compressor engines (P001-P006) to be installed at the Humphreys Compressor Station will be subject to this emissions standard.

2.5.4. OAC 3745-21-09(L) – Storage of Petroleum Liquids in Fixed Roof Tanks

The provisions of OAC-3745-21-09(L) prohibit the storage of any petroleum liquid with a TVP greater than 1.52 psia in fixed roof tanks unless such tanks meet the design requirements specified by the rule. All of the storage vessels at the Humphreys Compressor Station are fixed roof tanks with a capacity of less than forty thousand gallons and are thus exempt from the requirements of this rule per OAC 3745-21-09(L)(2)(a).

2.5.5. OAC 3745-21-09(M) – Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds

As provided in OAC 3745-21-01(E)(15) petroleum liquids are defined as,

> *"…crude oil, condensate, and any finished or intermediate products manufactured or extracted in a petroleum refinery."*

Additionally, petroleum refinery is defined per OAC 3745-21-01(E)(16),

> *"…any facility engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, lubricants, or other products through distillation of crude oil, or through redistillation, cracking, extraction, or reforming of unfinished crude oil derivatives."*

Finally, crude oil is defined by OAC 3745-21-01(E)(3) as,

> *"…a naturally occurring mixture which consists of hydrocarbons and/or sulfur, nitrogen, and/or oxygen derivatives of hydrocarbons and which is a liquid at standard conditions."*

Because the inlet natural gas to this facility is not liquid at standard conditions, the Humphreys Compressor Station does not process crude oil or a derivative of crude oil as defined above and the facility does not itself meet the definition of a petroleum refinery under OAC 3745-21-01(E); therefore, none of the liquids stored at the Humphreys Compressor Station would be classified as petroleum liquids subject to the requirements of OAC 3745-21-09(M).

2.5.6. OAC 3745-21-09(Q) & (V) – Bulk Gasoline Terminals and Gasoline Tank Trucks

The provisions of OAC 3745-21-09(Q) and (V) are not applicable to the Humphreys Compressor Station given that the material handled at the facility does not meet the definition of gasoline provided in OAC 3745-21-01 as "…any petroleum distillate which is used as a motor fuel and has an RVP of 4.0 pounds or greater."

2.5.7. OAC 3745-21-09(T) – Leaks from Petroleum Refinery Equipment

As noted above, none of the naturally occurring fluids processed at the Humphreys Compressor Station meet the definition of crude oil provided in OAC 3745-21-01(E)(3) as referenced in Section 2.5.6; therefore, the facility is not considered a petroleum refinery under OAC 3745-21-01(E)(16) and none of the components at the Humphreys Compressor Station are subject to the LDAR requirements of OAC 3745-21-09(T).

2.5.8. OAC 3745-21-09(DD) – Leaks from Process Units that Produce Organic Chemicals

The Humphreys Compressor Station will not produce as intermediates or as final products any of the compounds listed in Appendix A[5] to OAC 3745-21-09; therefore, none of the components at the facility are subject to the LDAR requirements of OAC 3745-21-09(DD).

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[5] The methanol additive used for dehydration of the process stream is not considered to be an intermediate or final product.

2.5.9. OAC 3745-21-21 – Storage of Volatile Organic Liquids in Fixed Roof Tanks and External Floating Roof Tanks

The Humphreys Compressor Station will not be located in any of the counties affected by this rule; therefore, the storage vessels are not subject to the standards of OAC 3745-21-21.

2.5.10. OAC 3745-110 – Nitrogen Oxides: Reasonably Available Control Technology

The provisions of OAC 3745-110 contain NO_X emissions limitations for various types of stationary ICE rated at output capacities greater than 2,000 hp. Although Compressor Engines #1-6 (P001-P006) are rated at capacities greater than 2,000 hp, the emission limits established for these units under Ohio EPA's best available technology (BAT) program (see Section 3) will be incorporated into the PTI issued for the Humphreys Compressor Station and will effectively limit potential NO_X emissions from each of the engines to less than 25 tpy. In accordance with OAC 3745-110-03(K)(17), any affected source issued a valid air operating permit restricting NO_X emissions to less than 25 tpy is considered exempt from the requirements of OAC 3745-110.

3. BEST AVAILABLE TECHNOLOGY (BAT) REVIEW

Pursuant to the provisions added to Ohio Revised Code (ORC) 3704 as a result of Senate Bill 265, sources modified or constructed after August 3, 2009, are to have rule-based BAT limits established by Ohio EPA for specific source categories. However, Ohio EPA has yet to promulgate the rule based BAT limits. To address this regulatory gap, the Ohio EPA's Division of Air Pollution Control (DAPC) released a memo (February 2014 Memo) indicating that permits filed on or after August 3, 2009, must go through an interim case-by-case BAT procedure.[6]

The first step in determining BAT, according to the February 2014 Memo, is to review MACT, GACT, BACT, and LAER applicability. The next step is to determine whether the operations are of the type and size that are regulated by Reasonable Available Control Technology (RACT) requirements for VOC emissions.

The third step in the BAT analysis is to determine BAT on a case-by-case basis by: 1) reviewing past BAT determinations, and 2) determining the format for the BAT limit, which should be expressed in one of the following ways:

(1) Work practices;
(2) Source design characteristics or design efficiency of applicable air contaminant control devices;
(3) Raw material specifications or throughput limitations averaged over a 12-month rolling period; or
(4) Monthly allowable emissions averaged over a 12-month rolling period.

Furthermore, the existing "less than 10 tpy" BAT exemption pursuant to OAC 3745-31-05(A)(3)(a)(ii) is not currently approved as part of Ohio's State Implementation Plan. Ohio EPA is currently in the process of revising the procedures for specifying BAT for sources that have potential emissions less than 10 tpy. In the interim, Ohio EPA is establishing BAT for these sources based on the guidance presented in the February 2014 Memo.[7]

3.1. BAT FOR COMPRESSOR ENGINES

The gas-fired compressor engines (P001-P006) are expected to generate emissions of gaseous pollutants (e.g., CO, VOC, NO_X, and SO_2) and particulate matter through the combustion of natural gas. As described in Section 2.2.1. of this application, these engines are subject to the capacity-based (i.e., g/hp-hr) NO_X, CO, and VOC emission standards provided in Table 1 to NSPS JJJJ. These limits satisfy the requirement to establish BAT for these pollutants as each engine is also subject to MACT ZZZZ which requires compliance with NSPS JJJJ. As a result, the Ohio Gathering Company is requesting BAT for NO_X, CO, and VOC in accordance with Section 2 of the February 2014 Memo. The Ohio Gathering Company requests monthly allowable emission limits for SO_2 and particulate matter as rolling, 12-month averages in accordance with the format described in Section 4.f. of Ohio EPA's February 2014 memo. Furthermore, the application of an oxidation

[6] Ohio EPA Memo from Mike Hopkins, Assistant Chief, Permitting, DAPC, to Permit Writers and Reviewers "BAT Requirements for Permits Issued On or After February 7, 2014" dated February 7, 2014, which supersedes the BAT guidance issued on August 30, 2013. Ohio's BAT policy will be in place only until such time when the Ohio EPA develops and promulgates rules that define BAT in accordance with ORC 3704.03(T) requirements.

[7] Question 34 of the February 2014 Memo.

catalyst controlling CO and VOC emissions is consistent with previous BAT determinations for similar sources (e.g., internal combustion engines under Standard Industrial Classification [SIC] code 1311 for Crude Petroleum and Natural Gas Extraction).

3.2. BAT FOR DEHYDRATOR FLARES

The combustion of gaseous material (i.e., off-gas) in the Dehydrator Regenerator Flares (P007-P008) is expected to generate emissions of gaseous pollutants (e.g., CO, VOC, NO_X, and SO_2) and particulate matter. The Ohio Gathering Company requests BAT limits for these pollutants as monthly allowable emission limits (in tons/month) averaged over a 12-month rolling period, consistent with Item 4.f. in the February 2014 Memo. Based on the short-term potential emission rates calculated in Appendix A, the Ohio Gathering Company requests the monthly allowable emission limits provided in Table 3-1.

3.3. BAT FOR EQUIPMENT BLOWDOWNS

Equipment Blowdowns (P009) include blowdowns of miscellaneous equipment resulting in uncontrolled emissions of VOC. These blowdown events are part of routine operation and maintenance at midstream natural gas compressor stations. The Ohio Gathering Company will conduct all related maintenance activities in a manner consistent with safety and good air pollution control practices. This includes minimizing the frequency and size of blowdown events. In accordance with Item 4.f. of the February 2014 Memo, the Ohio Gathering Company requests a monthly allowable emissions limitation averaged over a 12-month rolling period as provided in Table 3-1 below.

3.4. BAT FOR EQUIPMENT LEAKS

Equipment leaks from valves, compressors, pumps, and other components at the Humphreys Compressor Station will result in fugitive emissions of VOC. In accordance with Item 4.f of the February 2014 Memo, the Ohio Gathering Company requests a monthly allowable emissions limitation averaged over a rolling, 12-month period as provided in Table 3-1 below.

Table 3-1. Requested BAT Limits

		Emission Limitation[a] (tons/month)				
EUID	**Company ID**	**CO**	**VOC**	**NO_X**	**SO_2**	**PM**
P001	Compressor Engine #1				0.01	0.10
P002	Compressor Engine #2				0.01	0.10
P003	Compressor Engine #3				0.01	0.10
P004	Compressor Engine #4				0.01	0.10
P005	Compressor Engine #5				0.01	0.10
P006	Compressor Engine #6				0.01	0.10
P007	Dehydrator Flare	0.95	0.08	0.17	1.51E-03	0.02
P008	Dehydrator Flare	0.95	0.08	0.17	1.51E-03	0.02
P009	Equipment Blowdowns		0.05			
P801	Equipment Leaks		0.16			

[a] Emission limits in this table represent monthly emissions averaged over a 12-month rolling period.

Air dispersion modeling is sometimes necessary to demonstrate that a source will not: 1) violate Ohio EPA's policy whereby no new source exceeds the Ohio Acceptable Incremental Impact (AII) levels (i.e., consumes more than half of the available PSD increments), or 2) causes ground-level concentrations that exceed Ohio EPA's Maximum Allowable Ground Level Concentrations (MAGLCs) for toxic air pollutants.[8] This section of the PTI application describes the analysis that was conducted to address Ohio modeling requirements for the installation of the Humphreys Compressor Station.

4.1. REGULATED NSR POLLUTANT MODELING ANALYSIS

Engineering Guide #69: Air Dispersion Modeling Guidance (Engineering Guide #69) requires that increases in allowable emissions of regulated NSR pollutants from all new or modified sources be evaluated to determine whether the increases in allowable emissions exceed the Ohio modeling significant emission rates (SERs). For each regulated NSR pollutant for which the increase in allowable emissions exceeds the applicable SER, an air dispersion modeling analysis is required to demonstrate that the ambient incremental impact is less than the Ohio AII levels (one half of any PSD increment). Table 4-1 lists the Ohio modeling SERs and the corresponding Ohio AII levels.

Table 4-1. Ohio Modeling Significant Emission Rates

Pollutant	Ohio Modeling SER (tpy)	Ohio Acceptable Incremental Impact ($\mu g/m^3$)
PM_{10}	10	8.5 – Annual
		15 – 24-hr
$PM_{2.5}$	TBD	TBD – Annual
		TBD – 24-hr
NO_X	25	12.5 – Annual
SO_2	25	10 – Annual
		45.5 – 24-hr
		256 – 3-hr
CO	100	25,000 – 8-hr
		10,000 – 1-hr

As demonstrated in Table 1-1, the installation of the Humphreys Compressor Station will result in NO_X emissions increases exceeding 25 tpy, and the Ohio Gathering Company must demonstrate via air dispersion modeling that the proposed project will not result in ambient incremental impacts exceeding the applicable Ohio AII levels.

[8] Engineering Guide #69: Air Dispersion Modeling Guidance, Ohio EPA Air Quality Modeling and Planning Section, 2003, Page 4.

Ohio EPA has yet to establish Ohio AII levels corresponding to the 1-hour National Ambient Air Quality Standard (NAAQS) for NO_2. During the interim, Ohio EPA requests that applicants conduct air dispersion modeling to demonstrate that emissions attributable to new projects will not, in combination with the existing background concentrations of these pollutants in the region, cause exceedances of the applicable NAAQS.[9]

Although an Ohio modeling SER has yet to be established for $PM_{2.5}$, Ohio EPA is requesting during the interim that permit applicants perform state-level dispersion modeling of $PM_{2.5}$ for all projects for which emissions increases of $PM_{2.5}$ exceed 10 tpy.[10] As demonstrated in Table 1-1, the installation of the Humphreys Compressor Station will not result in potential emissions of $PM_{2.5}$ exceeding 10 tpy. Therefore, the Ohio Gathering Company is not required to perform dispersion modeling for $PM_{2.5}$.

4.1.1. Model Selection

Dispersion models predict downwind pollutant concentrations by simulating the evolution of the pollutant plume over time and space given data inputs. These data inputs include the quantity of emissions and the initial conditions of the stack exhaust. According to U.S. EPA's *Guideline on Air Quality Models* (the *Guideline)*, the extent to which a specific air quality model is suitable for the evaluation of source impacts depends on (1) the meteorological and topographical complexities of the area; (2) the level of detail and accuracy needed in the analysis; (3) the technical competence of those undertaking such simulation modeling; (4) the resources available; and (5) the accuracy of the database (i.e., emissions inventory, meteorological, and air quality data). Taking these factors under consideration, the Ohio Gathering Company used the AERMOD modeling system for representing all emission sources at the facility. AERMOD is the default model for evaluating impacts attributable to industrial facilities in the near-field (i.e., source receptor distances of less than 50 km), and is the recommended model in the *Guideline*.

4.1.1.1. AERMOD

The Ohio Gathering Company used version 13350 of the AERMOD modeling system to estimate maximum ground-level concentrations in all state-only analyses conducted for this application. AERMOD is a refined, steady-state, multiple source, Gaussian dispersion model and was promulgated in December 2005 as the preferred model for use by industrial sources in this type of air quality analysis.[11] The AERMOD model has the Plume Rise Modeling Enhancements (PRIME) incorporated in the regulatory version, so the direction-specific building downwash dimensions used as inputs are determined by the Building Profile Input Program, PRIME version (BPIP PRIME), version 04274.[12] BPIP PRIME is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash

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[9] Confirmed via telephone conversation between Myoungwoo Kim (Ohio EPA) and DJ Wheeler (Trinity Consultants) on December 14, 2011.

[10] Confirmed via telephone conversations between Sarah VanderWielen (Ohio EPA) and DJ Wheeler (Trinity Consultants) on April 17, 2013.

[11] 40 CFR Part 51, Appendix W–*Guideline on Air Quality Models*, Appendix A.1– AMS/EPA Regulatory Model (AERMOD).

[12] Earth Tech, Inc., *Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model,* Concord, MA.

Guidance document, and other related documents, while incorporating the PRIME enhancements to improve prediction of ambient impacts in building cavities and wake regions.[13]

The AERMOD modeling system is composed of three modular components: AERMAP, the terrain preprocessor; AERMET, the meteorological preprocessor; and AERMOD, the control module and modeling processor. AERMAP is the terrain pre-processor that is used to import terrain elevations for selected model objects and to generate the receptor hill height scale data that are used by AERMOD to drive advanced terrain processing algorithms. National Elevation Dataset (NED) data available from the USGS are used to interpolate surveyed elevations onto user specified receptor grids and buildings and sources in the absence of more accurate site-specific (i.e., site surveys, GPS analyses, etc.) elevation data.

AERMET generates a separate surface file and vertical profile file to pass meteorological observations and turbulence parameters to AERMOD. AERMET meteorological data are refined for a particular analysis based on the choice of micrometeorological parameters that are linked to the land use and land cover (LULC) around the particular facility and/or meteorological site.

Using the procedures outlined in the *Guideline* as a reference, the AERMOD dispersion modeling for the Humphreys Compressor Station was performed using all regulatory default options.

4.1.1.2. 1-Hour NO_2 State-Only Modeling

In the "Models for Nitrogen Dioxide" section of the *Guideline* (Section 5.2.4), U.S. EPA recommends a three-tiered screening approach for estimating annual NO_2 impacts from point sources in PSD modeling analyses. While the *Guideline* has not been revised to specifically address recommended modeling methodologies for the 1-hr NO_2 NAAQS analysis, recent U.S. EPA guidance suggests the approaches identified for the annual standard are generally applicable when applied to the new 1-hr standard.[14]

Under the initial and most conservative Tier 1 screening level, all NO_X emitted is modeled as NO_2 which assumes instantaneous and total conversion of NO (main chemical form of NO_X) to NO_2. For the Tier 2 screening level, U.S. EPA recommends in the *Guideline* multiplying the Tier 1 results by an empirically derived national default NO_2:NO_X ambient equilibrium ratio of 0.75 (annual average) and recommends use of a ratio of 0.80 (1-hour average) in recent guidance.[15] As an alternative to the default value, the reviewing agency may also establish a project-specific NO_2:NO_X ratio based on existing air quality data collected at representative ambient monitoring stations. Recent U.S. EPA guidance generally accepts the use of the aforementioned NO_2:NO_X ambient equilibrium ratio for Tier 2 1-hr NAAQS evaluations without further justification.[16] Therefore, the Ohio Gathering Company has adjusted the short- and long-term modeled

[13] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised),* Research Triangle Park, North Carolina, EPA 450/4-80-023R, June 1985.

[14] U.S. EPA Office of Air Quality Planning and Standards Memorandum from Tyler Fox, Leader to U.S. EPA Regional Air Division Directors entitled "Applicability of Appendix W Modeling Guidance for the 1-hr NO_2 National Ambient Air Quality Standard", June 28, 2010.

[15] Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, U.S. EPA, March 1, 2011.

[16] *Ibid.*

concentrations estimated in this state-only modeling analysis using the default ratios of 0.80 and 0.75, respectively.

4.1.2. Background Concentration

Ohio EPA recommends the development of a 1-hour NO_2 background concentration using monitoring data collected at monitoring stations throughout the state in accordance with U.S. EPA's March 1, 2011, guidance regarding the application of the 1-hr NO_2 standard.[17,18] The Athens, Ohio monitoring site (site ID 39-009-0004) was selected for determining the background concentrations of NO_2 for this project as it is the closest monitor with a land use type similar to that surrounding the Humphreys Compressor Station.[19]

The Ohio Gathering Company calculated the multi-year average of the monitored design value for the 1-hr NO_2 standard available from U.S. EPA's AirData repository to calculate a background concentration of 46 μg/m^3.[20] Subtracting this background concentration from the 1-hour NO_2 NAAQS (188 μg/m^3) yields an effective Ohio AII level of 142 μg/m^3.

4.1.3. Meteorological Data

Site-specific dispersion models require a sequential hourly record of dispersion meteorology representative of the region within which the source is located. In the absence of site-specific measurements, the *Guideline* suggests five years of reliable, quality assured, and representative meteorological data be used in regulatory modeling analyses. For this modeling analysis, the Ohio Gathering Company used the pre-processed meteorological data for Belmont County provided by Ohio EPA.[21] The files included five years (i.e., 2008-2012) of surface meteorological data and five years of upper air data from the Pittsburgh International Airport (PIT, WMO# 72520, WBAN# 94823).

4.1.4. Coordinate System

The location of emission sources, structures, and receptors are represented in the Universal Transverse Mercator (UTM) coordinate system. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 kilometers [km]). The datum for this modeling analysis is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis all reside within UTM Zone 17. The Ohio Gathering Company used to-scale aerial photos and site plans for the facility projected in UTM NAD83 Zone 17 to digitize all model objects.

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[17] Telephone conversation between Myoungwoo Kim (Ohio EPA) and DJ Wheeler (Trinity Consultants) on December 14, 2011.

[18] Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, U.S. EPA, March 1, 2011.

[19] The Athens NO_2 monitoring site (Site ID 39-009-0004) last reported data on December 31, 2011 and is currently inactive. However, as this monitor is the only monitor in Ohio located in a rural setting similar to that of the Humphreys Compressor Station, the 2009-2011 data from the monitor is used in this application for the purposes of developing a 1-hr NO_2 background concentration.

[20] http://www.epa.gov/airdata/

[21] Pre-processed meteorological data for each county in Ohio are available at http://epa.ohio.gov/dapc/model/modeling/metfiles.aspx

4.1.5. Treatment of Terrain

A designation of terrain at a particular receptor is source-dependent, since it depends on an individual source's effective plume height. AERMOD is capable of estimating impacts in both simple and complex terrain. Elevations for the off-site and boundary receptors near the Humphreys Compressor Station required by AERMOD were determined using the AERMAP terrain preprocessor (version 11103). Base elevations for sources and buildings at the Humphreys Compressor Station were determined using site grading plans. AERMAP also calculates receptor hill height parameters required by AERMOD. Terrain elevations from the USGS 1 arc-second NED data were used for the AERMAP processing of off-site and boundary receptors.

4.1.6. Receptor Grids

Because the Humphreys Compressor Station will be located in a rural area expected to exhibit limited public traffic, ground-level concentrations were calculated within Cartesian receptor grids and at receptors placed along the property line to determine the maximum estimated impact at a resolution of 100-meter grid spacing. The property grid and nested Cartesian grids described below covered a region extending from all edges of the Humphreys Compressor Station property boundary to the point where impacts from the project are no longer expected to be significant.

1. **Property Line Grid:** A "property line" grid consisting of evenly-spaced receptors 100 meters apart placed along the Humphreys Compressor Station property boundary.
2. **Fine Cartesian Grid:** A "fine" grid containing 100 meter spaced receptors extending out to approximately 4 km from the center of the property.
3. **Medium Cartesian Grid:** A "medium" grid containing 500 meter spaced receptors exclusive of receptors on the fine grid extending from 4 km to 7 km from the center of the property.
4. **Coarse Cartesian Grids:** Two (2) "coarse" grids containing 1,000 and 2,500 meter spaced receptors exclusive of receptors on the fine and medium grids extending from 7 to 15 km and from 15 to 50 km from the center of the facility, respectively.

AERMOD results confirmed that this set of grids covered all potential areas of interest where maximum concentrations were well within the modeling domain and also within the 100 meter grid receptors. As compliance with the Ohio AII levels is only required in areas regulated as "ambient air," in developing the receptor grid for the modeling analysis, the Ohio Gathering Company excluded all company owned property at the Humphreys Compressor Station since it is not considered "ambient air."

4.1.7. Building Downwash

The *Guideline* requires the evaluation of the potential for physical structures to affect the dispersion of emissions from stack sources. The exhaust from stacks that are located within specified distances of buildings and whose physical heights are below specified levels may be subject to "aerodynamic building downwash" under certain meteorological conditions. This determination is made by comparing actual stack height to the Good Engineering Practice (GEP) stack height. The modeled emission units and associated stacks and vents at the Humphreys Compressor Station were evaluated in terms of their proximity to nearby structures. All locations and dimensions of the buildings that were used in the modeling analysis are listed in the BPIP files contained in Appendix B.

All stacks were assumed to be subject to the effects of downwash if their release height is less than the minimum GEP stack height, which is defined by the following formula:

$H_{GEP} = H + 1.5L$

where,

H_{GEP}	=	minimum GEP stack height,
H	=	structure height, and
L	=	lesser dimension of the structure (height or maximum projected width).

This equation is limited to stacks located within 5L of a structure. Stacks located at a distance greater than 5L are not subject to the wake effects of the structure.

Direction-specific equivalent building dimensions used as inputs to the AERMOD model to simulate the impacts of downwash were calculated using the *BREEZE*®-AERMOD v7.8 software, developed by Trinity. This software incorporates the algorithms of the U.S. EPA-sanctioned Building Profile Input Program (BPIP-PRIME). Using the building coordinates and dimensions for all on-site structures, a GEP analysis of all modeled stacks in relation to each building for each of the 36 wind directions was performed to evaluate which building height and dimensions have the greatest influence in terms of building downwash on each source's emissions. Building downwash input and output files are provided on the modeling file CD in Appendix B.

4.2. SUMMARY OF CRITERIA POLLUTANT DISPERSION MODELING RESULTS

This section summarizes the results of the state-only dispersion modeling analysis and demonstrates that the installation of the Humphreys Compressor Station does not cause or contribute to an exceedance of Ohio's AII levels.

4.2.1. NO_2 State-Only Analysis

As discussed in Section 4.1, a state-only NO_2 modeling analysis was conducted to demonstrate the proposed project does not exceed the annual average AII level or the Ohio EPA recommended 1-hr AII level. The state-only modeling included all NO_X emission sources for the proposed project. The results of the state-only modeling analysis for NO_2 are provided in Table 4-2 and demonstrate that the installation of the Humphreys Compressor Station will not result in any exceedances of the Ohio AII levels.

Table 4-2. NO_2 State-Only Modeling Analysis Results

Averaging Period	Year for Met Data	OAII[a] (µg/m³)	Maximum Impact (µg/m³)	UTM East[b] (m)	UTM North[b] (m)
1-hour[c]	2008		95.49	484,008.6	4,417,585.0
	2009		91.98	484,008.6	4,417,585.0
	2010		94.47	484,008.6	4,417,585.0
	2011		96.55	484,008.6	4,417,585.0
	2012		86.41	484,100.1	4,416,775.0
	Max 5-yr Average	**142**	**92.94**	**484,008.6**	**4,417,585.0**
Annual[d]	2008		10.73	483,996.8	4,417,286.0
	2009		9.52	483,992.9	4,417,186.0
	2010		11.61	483,992.9	4,417,186.0
	2011		8.89	483,996.8	4,417,286.0
	2012		9.09	483,996.8	4,417,286.0
	Max of 5 years	**12.5**	**11.61**	**483,992.9**	**4,417,186.0**

[a] The effective 1-hr NO_2 OAII is calculated by subtracting the background concentration from the 1-hr NO_2 NAAQS.

[b] UTM coordinates are in NAD83 Zone 17.

[c] Evaluated five-year average 8th high 1-hour concentrations for comparison against the OAII.

[d] Evaluated maximum annual average concentration since OAII is not to be exceeded.

4.3. AIR TOXICS MODELING ANALYSIS

Item 1 of Ohio EPA's Engineering Guide #69 requires air dispersion modeling for each toxic pollutant for which the increase in allowable emissions exceeds one (1) tpy.[22] The air dispersion modeling must demonstrate that the ambient incremental impact is less than the Maximum Allowable Ground Level Concentrations (MAGLCs) established in accordance with Ohio EPA guidance as required by ORC 3704.03(F)(4)(b).[23]

Table 1-1 and Appendix A demonstrate that operations at the Humphreys Compressor Station will emit formaldehyde and hexane (toxic air pollutants) in quantities exceeding one (1) tpy. However, Ohio EPA provides in Item 4.2 of Engineering Guide #69 exceptions to the modeling thresholds established in Table 3 to Engineering Guide #69. Specifically, material transfer operations and emissions from storage tanks are not subject to toxics modeling. Therefore, Truck Loading Operations (J001) and Storage Tanks (T001-T006) are not included in the toxics modeling analysis.

Item 4.2 of Engineering Guide #69 also specifies that sources of toxic pollutants subject to an NSPS standard restricting emissions of such pollutants are also excluded from toxics modeling. NSPS JJJJ establishes NO_X, CO, and VOC limits for spark ignition internal combustion engines. Because emissions of hexane and formaldehyde from the compressor engines are emitted as VOC, these emissions would also be

[22] Air toxic pollutants include any pollutant listed in OAC 3745-114-01.

[23] ORC 3704.03(F)(4)(b) requires that applicable MAGLCs be determined in accordance with Option A: Review of New Sources of Air Toxic Emissions, Ohio EPA Air Quality Modeling and Planning Section (May 1986).

controlled under the emission limits established in NSPS JJJJ. Therefore, the compressor engines (P001-P006) are not subject to air toxics modeling in accordance with the exceptions provided in Item 4.2 of Engineering Guide #69.

5. PTI FORMS

PTI forms are being submitted within *Air Services* as required by the Ohio EPA to provide the necessary information for the issuance of a PTI for the proposed project.

6. EMISSION ACTIVITY CATEGORY FORMS

Emission Activity Category (EAC) forms are being submitted within *Air Services* as required by the Ohio EPA to provide the necessary information for the issuance of a PTI for the proposed project.

APPENDIX A

PTE Documentation

Table A.1 - Summary of Potential Emissions for the Humphreys Compressor Station

EU ID	Process/Facility	IEU Status (Yes/No)	IEU Specification	IEU Determination	Potential Emissions (tpy)									
					NO_X	CO	VOC	SO_2	Total PM	PM_{10}	$PM_{2.5}$	CO_2e[a]	CH_2O	HAPs
P001	Compressor Engine #1 - Caterpillar G3612TA	No	N/A	N/A	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P002	Compressor Engine #2 - Caterpillar G3612TA	No	N/A	N/A	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P003	Compressor Engine #3 - Caterpillar G3612TA	No	N/A	N/A	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P004	Compressor Engine #4 - Caterpillar G3612TA	No	N/A	N/A	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P005	Compressor Engine #5 - Caterpillar G3612TA	No	N/A	N/A	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P006	Compressor Engine #6 - Caterpillar G3612TA	No	N/A	N/A	17.14	6.51	5.40	0.07	1.17	1.17	1.17	13,715.76	1.03	1.59
P007	Dehydrator #1 Flare	No	N/A	N/A	2.10	11.35	0.96	0.02	0.23	0.23	0.23	1,986	8.89E-06	0.11
P008	Dehydrator #2 Flare	No	N/A	N/A	2.10	11.35	0.96	0.02	0.23	0.23	0.23	1,986	8.89E-06	0.11
P009	Equipment Blowdowns	No	N/A	N/A	-	-	0.58	-	-	-	-	209	-	0.04
P801	Fugitive Components	No	N/A	N/A	-	-	1.92	-	-	-	-	82	-	0.12
J001	Truck Loading Operations	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	-	-	0.28	-	-	-	-	2.08	-	0.07
B001	Dehydrator #1 Reboiler	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	1.07	0.90	0.06	0.01	0.08	0.08	0.08	1,410	8.05E-04	0.02
B002	Dehydrator #2 Reboiler	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	1.07	0.90	0.06	0.01	0.08	0.08	0.08	1,410	8.05E-04	0.02
F001	Compressor Station Roadways	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	-	-	-	-	0.28	0.07	0.007	-	-	-
T001	Storage Tank #1	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	1.50	-	-	-	-	11	-	0.35
T002	Storage Tank #2	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	1.50	-	-	-	-	11	-	0.35
T003	Storage Tank #3	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	1.50	-	-	-	-	11	-	0.35
T004	Storage Tank #4	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	1.50	-	-	-	-	11	-	0.35
T005	Storage Tank #5	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	1.50	-	-	-	-	11	-	0.35
T006	Methanol Storage Tank	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	-	-	0.03	-	-	-	-	-	-	--
Total Emissions (tpy)					**109.18**	**63.59**	**44.74**	**0.46**	**7.93**	**7.71**	**7.65**	**89,436**	**6.17**	**11.79**

[a] Carbon dioxide equivalent (CO_2e) emissions. Represents the sum of carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) emissions adjusted by each pollutant's global warming potential. None of the other six regulated GHG pollutants [i.e., hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)] are emitted from the affected emission units.

Table A.1a - Summary of Potential Uncontrolled Emissions for the Humphreys Compressor Station

EU ID	Process/Facility	IEU Status (Yes/No)	IEU Specification	IEU Determination	Uncontrolled Potential Emissions (lb/hr)									
					NO_X	CO	VOC	SO_2	Total PM	PM_{10}	$PM_{2.5}$	Hexane	CH_2O	HAPs
P001	Compressor Engine #1 - Caterpillar G3612TA	No	N/A	N/A	3.91	21.52	4.93	0.02	0.27	0.27	0.27	-	2.03	2.21
P002	Compressor Engine #2 - Caterpillar G3612TA	No	N/A	N/A	3.91	21.52	4.93	0.02	0.27	0.27	0.27	-	2.03	2.21
P003	Compressor Engine #3 - Caterpillar G3612TA	No	N/A	N/A	3.91	21.52	4.93	0.02	0.27	0.27	0.27	-	2.03	2.21
P004	Compressor Engine #4 - Caterpillar G3612TA	No	N/A	N/A	3.91	21.52	4.93	0.02	0.27	0.27	0.27	-	2.03	2.21
P005	Compressor Engine #5 - Caterpillar G3612TA	No	N/A	N/A	3.91	21.52	4.93	0.02	0.27	0.27	0.27	-	2.03	2.21
P006	Compressor Engine #6 - Caterpillar G3612TA	No	N/A	N/A	3.91	21.52	4.93	0.02	0.27	0.27	0.27	-	2.03	2.21
P007	Dehydrator #1 Flare	No	N/A	N/A	0.48	2.59	10.94	4.13E-03	0.05	0.05	0.05	1.29	2.03E-06	1.29
P008	Dehydrator #2 Flare	No	N/A	N/A	0.48	2.59	10.94	4.13E-03	0.05	0.05	0.05	1.29	2.03E-06	1.29
P009	Equipment Blowdowns	No	N/A	N/A	-	-	32.03	-	-	-	-	2.21	-	2.21
P801	Fugitive Components	No	N/A	N/A	-	-	0.44	-	-	-	-	0.03	-	0.03
J001	Truck Loading Operations	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	-	-	3.23	-	-	-	-	0.61	-	0.74
B001	Dehydrator #1 Reboiler	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	0.25	0.21	0.01	0.00	0.02	0.02	0.02	0.00	1.84E-04	0.00
B002	Dehydrator #2 Reboiler	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	0.25	0.21	0.01	0.00	0.02	0.02	0.02	0.00	1.84E-04	0.00
F001	Compressor Station Roadways	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	-	-	-	-	0.06	0.02	0.002	-	-	-
T001	Storage Tank #1	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	17.12	-	-	-	-	3.25	-	3.94
T002	Storage Tank #2	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	17.12	-	-	-	-	3.25	-	3.94
T003	Storage Tank #3	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	17.12	-	-	-	-	3.25	-	3.94
T004	Storage Tank #4	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	17.12	-	-	-	-	3.25	-	3.94
T005	Storage Tank #5	No	Permit Exempt	OAC 3745-31-03(A)(1)(l)(vi)	-	-	17.12	-	-	-	-	3.25	-	3.94
T006	Methanol Storage Tank	Yes	De Minimis	Potential Emissions < 10 lb/day, Total HAP < 1 tpy	-	-	0.01	-	-	-	-	-	-	-
				Total Emissions (tpy)	**24.93**	**134.73**	**172.80**	**0.11**	**1.81**	**1.76**	**1.75**	**21.71**	**12.21**	**38.50**

[a] Carbon dioxide equivalent (CO_2e) emissions. Represents the sum of carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) emissions adjusted by each pollutant's global warming potential. None of the other six regulated GHG pollutants [i.e., hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)] are emitted from the affected emission units.

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Table A.2 - Compressor Engine Emissions

Compressor Engine Emissions (Per Engine)
Engines #1-6 (P001 - P006)

Source Designation:	
Manufacturer:	Caterpillar
Model No.:	G3612 TA
Stroke Cycle:	4-stroke
Type of Burn:	Lean
Year Installed	2014
Fuel Used:	Field Gas
Fuel High Heating Value (HHV) (Btu/scf):	986
Rated Horsepower (bhp):	3,550
Specific Fuel Consumption (Btu/bhp-hr)	7,533
Maximum Fuel Consumption at 100% Load (scf/hr):	27,122
Heat Input (MMBtu/hr)	26.74

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	237.59

Criteria and Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors[a]	
NOx (uncontrolled)	0.50	g/bhp-hr
NOx	0.50	g/bhp-hr
CO (uncontrolled)	2.75	g/bhp-hr
CO	0.19	g/bhp-hr
SO_2	5.88E-04	lb/MMBtu
PM_{10} (Filterable)	7.71E-05	lb/MMBtu
$PM_{2.5}$ (Filterable)	7.71E-05	lb/MMBtu
PM Condensable	9.91E-03	lb/MMBtu
PM Total	9.99E-03	lb/MMBtu
VOC (uncontrolled, includes HCHO)	0.63	g/bhp-hr
VOC (includes HCHO)	0.16	g/bhp-hr
Formaldehyde (HCHO) (uncontrolled)	0.26	g/bhp-hr
Formaldehyde (HCHO)	0.03	g/bhp-hr

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	Potential Emissions (lb/hr)[b]	(tons/yr)[c]
NOx	3.91	17.14
CO (uncontrolled)	21.52	94.27
CO	1.49	6.51
SO_2	0.02	0.07
PM_{10} (Filterable)	0.002	0.01
$PM_{2.5}$ (Filterable)	0.002	0.01
PM Condensable	0.27	1.16
PM Total	0.27	1.17
VOC (uncontrolled)	4.93	21.60
VOC (Includes HCHO)	1.23	5.40
Formaldehyde (HCHO) (uncontrolled)	2.03	8.91
Formaldehyde (HCHO)	0.23	1.03

[a] SO2 and PM emission factors (excluding HCHO) from AP-42 Section 3.2, Table 3.2-2"Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines". NO_X, VOC, CO, and formaldehyde emission factors are based on manufacturer's data.
[b] Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr or bhp) × Emission Factor (lb/MMBtu or lb/bhp-hr).
[c] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8,760 hr/yr) × (1 ton/2000 lb).

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMBtu)[a,d]	Potential Emissions (lb/hr)[b]	(tons/yr)[c]
HAPs:			
1,1,2,2-Tetrachloroethane	1.00E-05	2.67E-04	1.17E-03
1,1,2-Trichloroethane	7.95E-06	2.13E-04	9.31E-04
1,1-Dichloroethane	5.90E-06	1.58E-04	6.91E-04
1,2-Dichloroethane	5.90E-06	1.58E-04	6.91E-04
1,2-Dichloropropane	6.73E-06	1.80E-04	7.88E-04
1,3-Butadiene	6.68E-05	1.79E-03	7.82E-03
1,3-Dichloropropene	6.60E-06	1.76E-04	7.73E-04
2,2,4-Trimethylpentane	6.25E-05	1.67E-03	7.32E-03
Acetaldehyde	2.09E-03	5.59E-02	2.45E-01
Acrolein	1.29E-03	3.44E-02	1.51E-01
Benzene	1.10E-04	2.94E-03	1.29E-02
Biphenyl	5.30E-05	1.42E-03	6.21E-03
Carbon Tetrachloride	9.18E-06	2.45E-04	1.07E-03
Chlorobenzene	7.60E-06	2.03E-04	8.90E-04
Chloroethane	4.68E-07	1.25E-05	5.48E-05
Chloroform	7.13E-06	1.91E-04	8.35E-04
Ethylbenzene	9.93E-06	2.65E-04	1.16E-03
Ethylene Dibromide	1.11E-05	2.96E-04	1.30E-03
Methanol	6.25E-04	1.67E-02	7.32E-02
Methylene Chloride	5.00E-06	1.34E-04	5.86E-04
n-hexane	2.78E-04	7.42E-03	3.25E-02
PAH	6.73E-06	1.80E-04	7.88E-04
Phenol	6.00E-06	1.60E-04	7.03E-04
Styrene	5.90E-06	1.58E-04	6.91E-04
Toluene	1.02E-04	2.73E-03	1.19E-02
Vinyl Chloride	3.73E-06	9.96E-05	4.36E-04
Xylene	4.60E-05	1.23E-03	5.39E-03
Total HAP (Includes Formaldehyde)		**0.36**	**1.59**

[a] SO_2, PM, and HAP emission factors (excluding HCHO) from AP-42 Section 3.2, Table 3.2-2"Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines". NO_X, VOC, CO, and formaldehyde emission factors are based on manufacturer's data.
[b] Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr or bhp) × Emission Factor (lb/MMBtu or lb/bhp-hr).
[c] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8,760 hr/yr) × (1 ton/2000 lb).
[d] HAP reduction of 75% using double oxidation catalyst

Table A.3 - Glycol Dehydrator #1 and #2 (P007 and P008)

Glycol Dehydrator Emissions[a]

GRI-GLYCalc Version 4.0 - EMISSIONS SUMMARY

EMISSION RATES

Pollutant	(lbs/hr)	(lbs/day)	(tons/yr)
Methane	2.3069	55.366	10.1044
Ethane	0.3464	8.314	1.5172
Propane	0.1045	2.508	0.4577
Isobutane	0.0322	0.773	0.1411
n-Butane	0.0323	0.775	0.1413
Isopentane	0.0140	0.336	0.0612
n-Pentane	0.0100	0.240	0.0439
n-Hexane	0.0258	0.619	0.1129
Cyclohexane	0.0000	0.000	0.0000
Other Hexanes	0.0000	0.000	0.0000
Heptanes	0.0000	0.000	0.0000
Benzene	0.0000	0.000	0.0000
Toluene	0.0000	0.000	0.0000
Xylenes	0.0000	0.000	0.0000
C8 + Heavier Hydrocarbons	0.0000	0.000	0.0000
Total Emissions	2.8721	68.9304	12.5797
Total VOC Emissions	0.2188	5.2512	0.9581
Total HAP Emissions	0.0258	0.6192	0.1129

[a] Controlled and uncontrolled emission rates taken from 'GRI-GLYCalc Version 4.0 - Aggregate Calculations Report', attached. These emissions are realized at the flares associated with these units (P007 and P008).

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Table A.4 - Dehydrator Flare #1 and #2 (P007 and P008)

Dehydrator Flare #1 and #2

Source Designation:	
Manufacturer:	Superior Fabrication
Year Installed	TBD
Operating Hours: (hr/yr)	8,760
Pilot Heat Input (MMBtu/hr)	0.028
Annual Fuel Use (mmscf/yr)	0.245
Fuel Consumption (mmscf/hr):	2.80E-05
Fuel HHV (Btu/scf)	986

	Emission Factors	
Pollutant	(lb/mmscf)[a]	lb/MMBtu[b]
NOx	96.7	0.098
CO	81.2	0.082
SO2	0.6	5.88E-04
VOC	5.1	5.20E-03
PM Total	7.3	7.45E-03
PM Condensable	5.5	5.59E-03
PM10 (Filterable)	1.8	1.86E-03
PM2.5 (Filterable)	1.8	1.86E-03

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Table 1.4-2 corrected for site-specific gas heat content.
[b] Emission factor (lb/MMBtu) = Emission Factor (lb/mmscf) / Fuel

Combustion of Hydrocarbons

Source Designation:	
Maximum Heat Release of Flare (mmbtu/hr)	7.0
Calculated Heat Release (mmbtu/hr) (based on GLYCalc)	3.2
Estimated Heat Content of Gas from Dehy (btu/scf)	1005.3
Maximum Heat Release of Flare (mmbtu/yr)	61,320
Calculated Heat Release (mmbtu/yr)	27,928
NOx Emission Rate (lb/mmbtu)[c]	0.068
CO Emission Rate (lb/mmbtu)[c]	0.37

[c] Emission factors from AP-42 Section 13.5 "Industrial Flares" Table 13.5-1

Total Emissions (Based on Maximum Heat Release)

Pollutant	lb/hr[b]	tpy[c]
NOx	4.79E-01	2.10E+00
CO	2.59E+00	1.14E+01
SO2	4.13E-03	1.81E-02
VOC (from Pilot Combustion)	1.43E-04	6.29E-04
PM Total	5.24E-02	2.29E-01
PM Condensable	3.93E-02	1.72E-01
PM10 (Filterable)	1.31E-02	5.73E-02
PM 2.5 (Filterable)	1.31E-02	5.73E-02

[d] Emission Rate (lb/hr) = Pilot Firing Rate (MMscf/hr) × Emission Factor (lb/MMscf) + Flare Heat Input Rate (MMBtu/hr) × Emission Factor (lb/MMBtu)
[e] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

NATURAL GAS HAP EMISSIONS (COMBUSTION OF PILOT FUEL)

HAPs	CAS No.	Natural Gas Emission Factor[a] (lb/MMscf)	Site-Specific Factor[b] (lb/MMscf)	Natural Gas Emission Factor (lb/MMBtu)	*Potential Emissions[c] (tpy)*
2-Methylnaphthalene	91-57-6	2.4E-05	2.3E-05	2.35E-08	*2.8E-09*
3-Methylchloranthrene	56-49-5	1.8E-06	1.7E-06	1.76E-09	*2.1E-10*
7,12-Dimethylbenz(a)anthracene	57-97-6	1.6E-05	1.5E-05	1.57E-08	*1.9E-09*
Acenaphthene	83-32-9	1.8E-06	1.7E-06	1.76E-09	*2.1E-10*
Acenaphthylene	203-96-8	1.8E-06	1.7E-06	1.76E-09	*2.1E-10*
Anthracene	120-12-7	2.4E-06	2.3E-06	2.35E-09	*2.8E-10*
Benz(a)anthracene	56-55-3	1.8E-06	1.7E-06	1.76E-09	*2.1E-10*
Benzene	71-43-2	2.1E-03	2.0E-03	2.06E-06	*2.5E-07*
Benzo(a)pyrene	50-32-8	1.2E-06	1.2E-06	1.18E-09	*1.4E-10*
Benzo(b)fluoranthene	205-99-2	1.8E-06	1.7E-06	1.76E-09	*2.1E-10*
Benzo(g,h,i)perylene	191-24-2	1.2E-06	1.2E-06	1.18E-09	*1.4E-10*
Benzo(k)fluoranthene	205-82-3	1.8E-06	1.7E-06	1.76E-09	*2.1E-10*
Chrysene	218-01-9	1.8E-06	1.7E-06	1.76E-09	*2.1E-10*
Dibenzo(a,h)anthracene	53-70-3	1.2E-06	1.2E-06	1.18E-09	*1.4E-10*
Dichlorobenzene	25321-22-6	1.2E-03	1.2E-03	1.18E-06	*1.4E-07*
Fluoranthene	206-44-0	3.0E-06	2.9E-06	2.94E-09	*3.6E-10*
Fluorene	86-73-7	2.8E-06	2.7E-06	2.75E-09	*3.3E-10*
Formaldehyde (HCOH)	50-00-0	7.5E-02	7.3E-02	7.35E-05	*8.9E-06*
Hexane	110-54-3	1.8E+00	1.7E+00	1.76E-03	*2.1E-04*
Indeno(1,2,3-cd)pyrene	193-39-5	1.8E-06	1.7E-06	1.76E-09	*2.1E-10*
Naphthalene	91-20-3	6.1E-04	5.9E-04	5.98E-07	*7.2E-08*
Phenanathrene	85-01-8	1.7E-05	1.6E-05	1.67E-08	*2.0E-09*
Pyrene	129-00-0	5.0E-06	4.8E-06	4.90E-09	*5.9E-10*
Toluene	108-88-3	3.4E-03	3.3E-03	3.33E-06	*4.0E-07*
Arsenic	7440-38-2	2.0E-04	1.9E-04	1.96E-07	*2.4E-08*
Beryllium	7440-41-7	1.2E-05	1.2E-05	1.18E-08	*1.4E-09*
Cadmium	7440-43-9	1.1E-03	1.1E-03	1.08E-06	*1.3E-07*
Chromium	7440-47-3	1.4E-03	1.4E-03	1.37E-06	*1.7E-07*
Cobalt	7440-48-4	8.4E-05	8.1E-05	8.24E-08	*1.0E-08*
Lead	7439-92-1	5.0E-04	4.8E-04	4.90E-07	*5.9E-08*
Manganese	7439-96-5	3.8E-04	3.7E-04	3.73E-07	*4.5E-08*
Mercury	7439-97-6	2.6E-04	2.5E-04	2.55E-07	*3.1E-08*
Nickel	7440-02-0	2.1E-03	2.0E-03	2.06E-06	*2.5E-07*
Selenium	7782-49-2	2.4E-05	2.3E-05	2.35E-08	*2.8E-09*
Polycyclic Organic Matter (POM)		8.8E-05	8.5E-05	8.65E-08	*1.0E-08*
Total HAP					*2.2E-04*

[a] Emission factors from AP-42, Tables 1.4-2, 1.4-3, and 1.4-4 (7/98).
[b] Site Specific Factor (lb/mmscf) = Emission Factor (lb/mmscf) * Site Specific Heat Content (btu/scf) / Standard Heat Content of Natural Gas of 1020 (btu/scf)
[c] Potential Emissions (tpy) = Site Specific Emission Factor (lb/mmscf) * Annual Fuel Usage (mmscf/yr) / 2000 (lb/ton)

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Table A.5 - Dehydrator Reboiler #1 and #2 (B001 and B002)

Dehydration Unit Reboiler #1 and #2

Source Designation:	
Manufacturer:	Unknown
Year Installed	TBD
Fuel Used:	Field Gas
Higher Heating Value (HHV) (Btu/scf):	986
Heat Input (MMBtu/hr)	2.50
Fuel Consumption (mmscf/hr):	2.53E-03
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	**Emission Factor (lb/MMscf)[a]**	**Potential Emissions (lb/hr)[b]**	**(tons/yr)[c]**
NO_x	96.7	0.245	1.074
CO	81.2	0.206	0.902
SO_2	0.6	0.001	0.006
PM Total	7.3	0.019	0.082
PM Condensable	5.5	0.014	0.061
PM_{10} (Filterable)	1.8	0.005	0.020
$PM_{2.5}$ (Filterable)	1.8	0.005	0.020
VOC	5.3	0.013	0.059

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3 (07/98) for all criteria and HAP pollutants, corrected to site-specific gas heat content.
[b] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf).
[c] Annual Emissions $(tons/yr)_{Potential} = (lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

Hazardous Air Pollutant (HAP) Potential Emissions from Dehy Reboiler

Pollutant	**Emission Factor (lb/MMscf)[a]**	**Potential Emissions (lb/hr)[b]**	**(tons/yr)[c]**
HAPs:			
3-Methylchloranthrene	1.74E-06	4.41E-09	1.93E-08
7,12-Dimethylbenz(a)anthracene	1.55E-05	3.92E-08	1.72E-07
Acenaphthene	1.74E-06	4.41E-09	1.93E-08
Acenaphthylene	1.74E-06	4.41E-09	1.93E-08
Anthracene	2.32E-06	5.88E-09	2.58E-08
Benz(a)anthracene	1.74E-06	4.41E-09	1.93E-08
Benzene	2.03E-03	5.15E-06	2.25E-05
Benzo(a)pyrene	1.16E-06	2.94E-09	1.29E-08
Benzo(b)fluoranthene	1.74E-06	4.41E-09	1.93E-08
Benzo(g,h,i)perylene	1.16E-06	2.94E-09	1.29E-08
Benzo(k)fluoranthene	1.74E-06	4.41E-09	1.93E-08
Chrysene	1.74E-06	4.41E-09	1.93E-08
Dibenzo(a,h) anthracene	1.16E-06	2.94E-09	1.29E-08
Dichlorobenzene	1.16E-03	2.94E-06	1.29E-05
Fluoranthene	2.90E-06	7.35E-09	3.22E-08
Fluorene	2.71E-06	6.86E-09	3.01E-08
Formaldehyde	7.25E-02	1.84E-04	8.05E-04
Hexane	1.74E+00	4.41E-03	1.93E-02
Indeno(1,2,3-cd)pyrene	1.74E-06	4.41E-09	1.93E-08
Phenanthrene	1.64E-05	4.17E-08	1.83E-07
Pyrene	4.83E-06	1.23E-08	5.37E-08
Toluene	3.29E-03	8.33E-06	3.65E-05
Arsenic	1.93E-04	4.90E-07	2.15E-06
Beryllium	1.16E-05	2.94E-08	1.29E-07
Cadmium	1.06E-03	2.70E-06	1.18E-05
Chromium	1.35E-03	3.43E-06	1.50E-05
Cobalt	8.12E-05	2.06E-07	9.02E-07
Lead	4.83E-04	1.23E-06	5.37E-06
Manganese	3.67E-04	9.31E-07	4.08E-06
Mercury	2.51E-04	6.37E-07	2.79E-06
Nickel	2.03E-03	5.15E-06	2.25E-05
Selenium	2.32E-05	5.88E-08	2.58E-07
Polycyclic Organic Matter:			
2-Methylnaphthalene	2.32E-05	5.88E-08	2.58E-07
Naphthalene	5.90E-04	1.50E-06	6.55E-06
Total HAP		**4.63E-03**	**2.03E-02**

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3 (07/98) for all criteria and HAP pollutants, corrected to site-specific gas heat content.
[b] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf).
[c] Annual Emissions $(tons/yr)_{Potential} = (lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

Table A.6 - Flashing Emissions from Tanks (T001-T005)

Flashing losses from storage tanks T001 - T005 are estimated by assuming that the quantity of liquid delivered to the tanks is equal to the quantity of incoming hexane to the compressor station (i.e., assuming the entirety of hydrocarbons with six or more carbons are present in liquid phase). This liquid flow rate is then used with an industry-standard assumption regarding the quantity of flash emissions per barrel of throughput to estimate the gaseous flash emissions emanating from the tanks.

Mole Fraction Hexane	8.00E-04	[mol frac]	*Per inlet gas analysis [based on representative gas analysis for Stutzman Well (January 2014)]*
Inlet Gas Flow Rate to Humphreys CS	240	mmscfd	*Site processing capacity*
Gas Flow Rate	26,351.79	lb-mol/hr	*= Gas Flow Rate (mmscfd) * 2635.144 (lb-mol/mmscf) / 24 (hrs/day), using Ideal Gas Law*
Hexane Flow Rate	21.08	lb-mol/hr	*= Gas Flow Rate (lbmoles/hr) * Mole Fraction Hexane*
Hexane Molecular Weight	86.18	lb/lb-mol	
Hexane Flow Rate	1,816.75	lbs/hr	*= Hexane Flow Rate * Hexane Molecular Weight*
Hexane Liquid Density	41.37	lb/ft^3	
SCF/BBL liquid emanated to VRU	108.00	scf/bbl	*Assume 108 SCF/BBL of liquid emanated from tanks [consistent with simulated Hoskins compressor station (winter case)]*
Mole Weight of Gas emanated to VRU	37.20	lb/lb-mol	*Assume 37.2 Molecular weight of gas emanated from tanks [consistent with simulated Hoskins compressor station (winter case)]*
Control Efficiency	98.00	%	*VRU Control Efficiency*
Hexane Liquid Volume Rate	7.82	bbls/hr	*= Hexane Flow Rate (lbs/hr) / Hexane Ideal Liquid Density (lb/ft^3) * 7.48 (gal/ft^3) / 42 (gal/bbl)*
Hexane Liquid Volume Rate	328.51	gal/hr	*= Hexane Liquid Volume Flow Rate (bbls/hr) * 42 (gal/day)*
Hexane Liquid Volume Rate	2,877,790.17	gal/yr	*= Hexane Liquid Volume Flow Rate (gal/hr) * 8760 (hr/yr)*
Hexane Liquid Volume Rate (per Tank)	575,558.03	gal/yr/tank	*= Hexane Liquid Volume Flow Rate (gal/yr) / 5 Tanks*
Gas Emanated from Tanks	362.70	tpy	*= Hexane Liquid Volume Flow Rate (bbls/hr) * 108 (scf/bbl) * 2635.144 (lb-mol/mmscf) * Molar Weight of Gas Emanated to VRU (lb/lb-mol) * 8760 (hrs/yr) / 1,000,000 (mmscf/scf) / 2000 (lbs/ton)*
Controlled Emissions	7.25	tpy	*= (1 - Control Efficiency) * Gas Emanated from Tanks*

Table A.7 - Storage Tank (T001-T005) Emissions

Storage Tanks (Controlled by VRU)

Process Parameters

HAP Composition	23.00	wt %	Conservatively assumes gaseous emissions have the same constituency as liquid stream (as determined by C6+ Lab Analysis maintained internally by MarkWest)
Hexane Composition	19.00	wt %	Conservatively assumes gaseous emissions have the same constituency as liquid stream (as determined by C6+ Lab Analysis maintained internally by MarkWest)
CO2 Composition	0.20	wt %	Assumed to be consistent with HYSYS Run provided by N. Wheldon via email on 11/1/12
Methane Composition	29.44	wt %	Assumed to be consistent with HYSYS Run provided by N. Wheldon via email on 11/1/12
Methane GWP	25		40 CFR 98 Subpart A, Table A-1

	Emissions (tpy)		
	Uncontrolled	**Controlled**[a]	
Individual Tank Working Losses[a]	1.73	0.035	As modeled by TANKS 4.0.9d (see TANKS attached output file)
Individual Tank Breathing Losses[a]	0.73	0.015	As modeled by TANKS 4.0.9d (see TANKS attached output file)
Combined Flashing Losses - Calculated	362.70	7.254	See 'Flashing Emissions from Tanks'
Total Working Losses[c]	8.66	0.173	Total Losses (tpy) = Individual Losses (tpy) * 5 Tanks
Total Breathing Losses[c]	3.65	0.073	Total Losses (tpy) = Individual Losses (tpy) * 5 Tanks
Total VOC Emissions from Tanks T001-T005[d]	375.02	7.500	Total Emissions (tpy) = Total Working Losses (tpy) + Total Breathing Losses (tpy)
Total Methane Emissions from Tanks T001-T005[e]	110.41	2.208	Total Methane Emissions (tpy) = Total VOC Emissions (tpy) * Methane Composition (wt %)
Total CO_2 Emissions from Tanks T001-T005[e]	0.77	0.015	Total CO_2 Emissions (tpy) = Total VOC Emissions (tpy) * CO_2 Composition (wt %)
Total CO_2e Emissions from Tanks T001-T005[e]	2761.07	55.221	Total CO_2e Emissions (tpy) = Annual CO_2 Emissions (tpy) x CO_2 GWP + Annual CH_4 Emissions (tpy) x CH_4 GWP
Total HAP Emissions from Tanks T001-T005[e]	86.25	1.725	Total HAP Emissions (tpy) = Total VOC Emissions (tpy) * HAP Composition (wt %)
Total Hexane Emissions from Tanks T001-T005[e]	71.25	1.425	Total Hexane Emissions (tpy) = Total VOC Emissions (tpy) * Hexane Composition (wt %)
Estimated VOC Emissions per Tank[f]	75.00	1.500	Estimated Emissions per Tank (tpy) = Total Emissions from Tanks T001-T005 (tpy) / 5 Tanks
Estimated Methane Emissions per Tank	22.08	0.442	Estimated Emissions per Tank (tpy) = Total Emissions from Tanks T001-T005 (tpy) / 5 Tanks
Estimated CO_2 Emissions per Tank	0.15	0.003	Estimated Emissions per Tank (tpy) = Total Emissions from Tanks T001-T005 (tpy) / 5 Tanks
Estimated CO_2e Emissions per Tank	552.21	11.044	Estimated Emissions per Tank (tpy) = Total Emissions from Tanks T001-T005 (tpy) / 5 Tanks
Estimated HAP Emissions per Tank	17.25	0.345	Estimated Emissions per Tank (tpy) = Total Emissions from Tanks T001-T005 (tpy) / 5 Tanks
Estimated Hexane Emissions per Tank	14.25	0.29	Estimated Emissions per Tank (tpy) = Total Emissions from Tanks T001-T005 (tpy) / 5 Tanks

[a] Controlled Emissions (tpy) = Uncontrolled Emissions (tpy) * [1 - VRU Control Efficiency (98%)]

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Humphreys Compressor Station

Table A.8 - Fugitive Component Emissions (P801)

Fugitive Leaks												
Equipment type	**Count**	**Leak Emission Factors lb/hr/component[c]**	**Source of Leak Emission Factors (Specify if EPA protocol or others)**	**Stream Type (Gas/Liquid etc)**	**Gas VOC Wt%[d]**	**Gas HAP Wt %**	**Light Oil VOC Wt %[e]**	**Light Oil HAP Wt %**	**Potential VOC Emissions[f] (lb/hr)**	**Potential VOC Emissions[g] (tpy)**	**Potential HAP Emissions[h] (lb/hr)**	**Potential HAP Emissions[i] (tpy)**
Connectors/Flanges	72	8.60E-04	EPA Protocol	Natural Gas	5.60%	0.39%	100.00%	6.30%	0.0035	0.0152	0.0002	0.0010
Connectors/Flanges	36	2.43E-04	EPA Protocol	Light Oil	5.60%	0.39%	100.00%	6.30%	0.0087	0.0383	0.0006	0.0024
Connectors/Flanges	36	6.39E-06	EPA Protocol	Water/Light Oil	5.60%	0.39%	100.00%	6.30%	0.0002	0.0010	0.0000	0.0001
Compressors	6	1.94E-02	EPA Protocol	Natural Gas	5.60%	0.39%	100.00%	6.30%	0.0065	0.0285	0.0004	0.0020
Open-Ended Lines	6	4.41E-03	EPA Protocol	Natural Gas	5.60%	0.39%	100.00%	6.30%	0.0015	0.0065	0.0001	0.0004
Pump Seals	0	5.29E-03	EPA Protocol	Natural Gas	5.60%	0.39%	100.00%	6.30%	0.0000	0.0000	0.0000	0.0000
Pump Seals	6	2.87E-02	EPA Protocol	Light Oil	5.60%	0.39%	100.00%	6.30%	0.1720	0.7532	0.0108	0.0475
Pump Seals	6	5.20E-05	EPA Protocol	Water/Light Oil	5.60%	0.39%	100.00%	6.30%	0.0003	0.0014	0.0000	0.0001
Valves	72	9.92E-03	EPA Protocol	Natural Gas	5.60%	0.39%	100.00%	6.30%	0.0400	0.1751	0.0028	0.0121
Valves	36	5.50E-03	EPA Protocol	Light Oil	5.60%	0.39%	100.00%	6.30%	0.1980	0.8672	0.0125	0.0546
Valves	36	2.16E-04	EPA Protocol	Water/Light Oil	5.60%	0.39%	100.00%	6.30%	0.0078	0.0341	0.0005	0.0021
								Total	**0.4385**	**1.9205**	**0.0279**	**0.1223**

[a] *"Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc.*

[b] *The component count is a preliminary estimate based on the proposed facility design.*

[c] *Table 2-4. Oil & Gas Production Operations Average Emission Factors, Protocol for Equipment Leak Emission Estimates, EPA 453/R-95-017, November 1995. Emission factors converted to lb/hr/component and based on average measured TOC from component types indicated in gas or light oil service at O&G Production Operations.*

[d] *Gaseous VOC and HAP weight percent based on representative gas analysis for Stutzman Well January 2014*

[e] *No analysis for Water/Light Oil; assume it is same VOC percentage as Light Oil to be conservative.*

[f] *VOC Emissions (lb/hr) = Component Count * Emission Factor (lb/hr/component) * Applicable Stream Type VOC Wt %*

[f] *VOC Emissions (tpy) = VOC Emissions (lb/hr) * 8760 (hrs/yr) / 2000 (lb/ton)*

[f] *HAP Emissions (lb/hr) = Component Count * Emission Factor (lb/hr/component) * Applicable Stream Type HAP Wt %*

[f] *HAP Emissions (tpy) = HAP Emissions (lb/hr) * 8760 (hrs/yr) / 2000 (lb/ton)*

Table A.9 - Blowdown Emissions (P009)

Blowdown Emission Estimates

Station	Type of Engine	Number of Engines	Station Capacity (mmscf/d)	Total Engine Blowdown Emissions[a] (lbs/yr)	Total Pollutant Blowdown Emissions[d]			
					VOC[b] (tpy)	HAPs[b] (tpy)	CO2e from CO2[b] (tpy)	CO2e from CH4[b,c] (tpy)
Humphreys CS	CAT. G3612 TA	6	240	20601	0.58	0.04	0.08	209.25

[a] Total Site Blowdown Emissions (lbs/yr) = Number of Engines * 3 Blowdowns per Month * 12 Months per Year * 95.4 (lbs emissions per blowdown event per engine), where 95.4 lbs per blowdown per engine is determined based on 36 lbs per blowdown from CAT 3516B engine * 3550/1340 (ratio of CAT G3612 hp: CAT3608 hp)

[b] VOC, CO2, CH4, and HAP weight percent based on representative gas analysis for Stutzman Well January 2014

[c] Global warming potential from 40 CFR 98, "2013 Revisions to the Greenhouse Gas Reporting Rule and Final Confidentiality Determination for New or Substantially Revised Data Elements". Table 2 - GHGs with Revised GWPs for Table A-1.

[d] Total Pollutant Blowdown Emissions (tpy) = Total Blowdown Emissions (lbs/yr) * Component Composition (wt %) / 2000 (lbs/ton)

Table A.10 - Truck Loading Potential Emissions (J001)

Loading Loss Equation, AP-42, Section 5.2.2.1.1 (June 2008)
LL = 12.46 x SPM/(T_R)

where:
LL = Loading Losses (lb/mgal Loaded)
S = saturation factor from AP-42 Table 5.2-1
P = true vapor pressure of liquid (psia)
M = molecular weight of vapors (lb/lbmole)
T_R = temperature of liquid loaded, °R

DIMENSIONAL ANALYSIS

Volume Conversion	42	gallons/bbl	*NIST SP1038*
Volume Conversion	1,000	gal/Mgal	
Mass Conversion	2,000	lb/ton	*NIST SP1038*
Time Conversion	60	min/hr	
Time Conversion	24	hours/day	
Time Conversion	365	days/yr	
Time Conversion	8,760	hours/yr	

MATERIAL PARAMETERS & OPERATING RATES

Gas Condensate Molecular Weight (M)	86.2	lb/lbmol	*Assume liquid volume flow to tanks that is equivalent to hexane inlet flow to station; AP-42, Section 7.1, Table 7.1*
VOC Mass Percent	100.00%		*Per C6+ Lab Analysis maintained internally by MarkWest*
Hexane Mass Percent	19.00%		*Per C6+ Lab Analysis maintained internally by MarkWest*
HAP Mass Percent	23.00%		*Per C6+ Lab Analysis maintained internally by MarkWest*
Vapor Return Line Collection Efficiency	98%		*AP-42 Section 5.2, Page 5.2-5 [trucks meet NSPS-level testing per 11/9/12 call w/ N. Wheldon]*
Saturation Factor (S)	0.60		*AP-42, Section 5.2, Table 5.2-1. for submerged loading in dedicated normal service per 11/9/12 call w/ N. Wheld*
Daily Maximum Ambient Temperature	82.3	F	*TANKS 4.0.9d data for Akron, OH for the month of July*
Daily Maximum Ambient Temperature (T1)	542	R	*NIST SP1038*
Maximum True Vapor Pressure (P1)	6.80	psia	*Consistent with Barnesville Compressor station*
Loading Losses (L_{L1})	8.09	lb/Mgal	*Calculated according to Eqn. 1 of AP-42, Section 5.2 using the maximum true vapor pressure (P1) and daily maximum ambient temperature (T1); assumes all loading losses are VOC*
Daily Average Ambient Temperature	49.7	F	*TANKS 4.0.9d data for Akron, Ohio*
Daily Average Ambient Temperature (T2)	509	R	*NIST SP1038*
Gas Condensate Annual Average Vapor Pressure (F	6.80	psia	*Consistent with Barnesville Compressor station*
Loading Losses (L_{L2})	8.60	lb/Mgal	*Calculated according to Eqn. 1 of AP-42, Section 5.2 using the annual average vapor pressure (P2) and the daily average ambient temperature (T2); assumes all loading losses are VOC*
Maximum Daily Truck Loading	9,000	gal/day	*Maximum expected tank loading provided by N. Wheldon via email on 11/1/12*
Maximum Hourly Truck Loading	9.00	Mgal/hr	*Assumes the tank loading is performed within a 1 hour time period*
Average Annual Truck Loading	3,285	Mgal/yr	*NIST SP1038*
CO_2 Mass Fraction	0.002		
CH_4 Mass Fraction	0.29		
GWP - CO_2	1		*40 CFR 98 Subpart A, Table A-1*
GWP - CH_4	25	GWP	*40 CFR 98 Subpart A, Table A-1*

TRUCK LOADING POTENTIAL EMISSIONS

Hourly VOC Emissions	1.46	lb/hr	*= Maximum Hourly Truck Loading (Mgal/hr) x Loading Losses L_{L1} (lb/Mgal) x (1 - Collection Efficiency)*
Annual VOC Emissions	0.28	tpy	*= Average Annual Truck Loading (Mgal/yr) x Loading Losses L_{L2} (lb/Mgal) / 2000 (lb/ton) x (1 - Collection Effic*
Hourly Hexane Emissions	0.28	lb/hr	*= Hourly VOC Emissions (lb/hr) x Mass Percent Hexane*
Annual Hexane Emissions	0.05	tpy	*= Annual VOC Emissions (tpy) x Mass Percent Hexane*
Hourly Total HAP Emissions	0.33	lb/hr	*= Hourly VOC Emissions (lb/hr) x Mass Percent HAP*
Annual Total HAP Emissions	0.07	tpy	*= Annual VOC Emissions (tpy) x Mass Percent HAP*
Annual CO_2 Emissions	5.77E-04	tpy	*= Annual Controlled VOC Emissions (tpy) x CO_2 Mass Fraction*
Annual CH_4 Emissions	8.32E-02	tpy	*= Annual Controlled VOC Emissions (tpy) x CH_4 Mass Fraction*
Annual CO_2e Emissions	2.08	tpy	*= Annual CO_2 Emissions (tpy) x CO_2 GWP + Annual CH_4 Emissions (tpy) x CH_4 GWP*

Table A.11 - Plant Roadway Potential Emissions (F001)

$E = k\,(s/12)^a (W/3)^b\,(365-P)/365$ *AP-42 Section 13.2.2, Equations 1a and 2*

VEHICLE PARAMETERS

Personnel Truck Trips - Route 1	4	vehicles/day	*Provided by N. Wheldon via email on 10/16/12*
Tanker Truck Trips	1	vehicle/day	*Provided by N. Wheldon via email on 11/1/12*
Empty Tanker Truck Weight	20	tons	*Assumed*
Water Truck Capacity	9,000	gal	*Assumed to be consistent with tanker truck size*
Condensate Density	5.53	lb/gal	*Based on hexane density*
Loaded Truck Weight	44.89	tons	*= Empty Truck Weight (tons) + Truck Capacity (gal) x Gasoline Density (lb/gal) / 2,000 (lb/ton)*
Average Personnel Truck Weight	2	tons	*Assumed*
Average Tanker Truck Weight	32.44	tons	*= [Empty Tanker Truck Weight (tons) + Loaded Tanker Truck Weight (tons)]/2*
Average Distance Travelled by Personnel (Round Trip)	4,640	feet/vehicle	*Estimated using Google Earth*
Average Distance Travelled by Trucks (Round Trip)	2,507	feet/vehicle	*Estimated using Google Earth*

OPERATING PARAMETERS

Potential Annual Hours of Operation	8,760	hr/yr	
VMT - Personnel Trucks	3.52	miles/day	*= Personnel Trucks (vehicles/day) x Distance Traveled (feet/vehicle) / 5,280 (ft/mile)*
VMT - Tanker Trucks	0.475	miles/day	*= Tanker Trucks (vehicles/day) x Distance Traveled (feet/vehicle) / 5,280 (ft/mile)*
Weighted Average Vehicle Weight	5.62	tons	*Weighted against vehicle miles travelled on unpaved roads*
Number of Days w/ at least 0.01" of Precipitation	140	days	*AP-42 Section 13.2.2, Figure 13.2.2-1*
Silt Loading	4.3	%	*AP-42 Section 13.2.2, Table 13.2.2-1 for Taconite mining service roads (11/06)*
Speed Limit Control Efficiency - 15 mph	80	%	*Proposed control measure efficiency per Ohio EPA 1980 RACM Guide Section 2.1.1*

DIMENSIONAL ANALYSIS

Mass Conversion	2,000	lb/ton
Length Conversion	5,280	ft/mile
Volume Conversion	7.48	gal/ft^3
Time Conversion	365	days/yr
Time Conversion	24	hr/day

EMISSION FACTORS

Pollutant	***Emission Factor***	***Units***	***Source***
Particle Size Multiplier - PM (k)	4.9	lb/VMT	*AP-42 Section 13.2.2, Table 13.2.2-2 (11/06)*
Particle Size Multiplier - PM10 (k)	1.5	lb/VMT	*AP-42 Section 13.2.2, Table 13.2.2-2 (11/06)*
Particle Size Multiplier - PM2.5 (k)	0.15	lb/VMT	*AP-42 Section 13.2.2, Table 13.2.2-2 (11/06)*
Empirical Constant - PM, a	0.7		*AP-42 Section 13.2.2, Table 13.2.2-2 (11/06)*
Empirical Constant - $PM_{10}/PM_{2.5}$, a	0.9		*AP-42 Section 13.2.2, Table 13.2.2-2 (11/06)*
Empirical Constant - $PM/PM_{10}/PM_{2.5,}$ b	0.45		*AP-42 Section 13.2.2, Table 13.2.2-2 (11/06)*
PM Emission Factor - Daily Basis	0.63	lb/VMT	$E = k_{PM}\,(s/12)^a\,(W/3)^b \times (1-CE_{speed})$
PM_{10} Emission Factor - Daily Basis	0.16	lb/VMT	$E = k_{PM10}\,(s/12)^a\,(W/3)^b \times (1-CE_{speed})$
$PM_{2.5}$ Emission Factor - Daily Basis	0.02	lb/VMT	$E = k_{PM2.5}\,(s/12)^a\,(W/3)^b \times (1-CE_{speed})$
PM Emission Factor - Annual Basis	0.39	lb/VMT	$E = k_{PM}\,(s/12)^a\,(W/3)^b \times (365-P)/365 \times (1-CE_{speed})$
PM_{10} Emission Factor - Annual Basis	0.10	lb/VMT	$E = k_{PM10}\,(s/12)^a\,(W/3)^b \times (365-P)/365 \times (1-CE_{speed})$
$PM_{2.5}$ Emission Factor - Annual Basis	0.01	lb/VMT	$E = k_{PM2.5}\,(s/12)^a\,(W/3)^b \times (365-P)/365 \times (1-CE_{speed})$

ROADWAY POTENTIAL EMISSIONS

Pollutant	***(lb/day)*** [a]	***(lb/hr)*** [b]	***(tons/yr)*** [c]
PM	2.53	0.11	0.28
PM_{10}	0.63	0.03	0.07
$PM_{2.5}$	0.06	0.00	0.01

[a] *Emissions (lb/day) = $PM/PM_{10}/PM_{2.5}$ Emission Factor Daily Basis (lb/VMT) x Vehicle Miles Travelled (miles/day)*

[b] *Hourly Emissions (lb/hr) = Daily Emissions (lb/day)/24 (hr/day)*

[c] *Annual Emissions (tpy) = $PM/PM_{10}/PM_{2.5}$ Emission Factor Annual Basis (lb/VMT) x Vehicle Miles Travelled (miles/day) x 365 (days/yr) / 2,000 (lb/ton)*

Table A.12 - GHG Emissions from Dehydrators and Fugitive Components

Dehydrator #1 and #2 (P007 and P008) GHG Calculation[a]

Constituent	Uncontrolled Emission Rate (tpy)	Controlled Emission Rate (tpy)	Carbon from Combustion[b] (tpy)	CO2 Emissions[c] (tpy)
Methane	505.2191	10.1044	370.4100	1358.4787
Ethane	75.8595	1.5172	59.3354	217.6125
Propane	22.8853	0.4577	18.3082	67.1455
i-butane	7.0556	0.1411	5.7105	20.9434
n-butane	7.0658	0.1413	5.7188	20.9737
i-pentane	3.0587	0.0612	2.4927	9.1421
n-pentane	2.1926	0.0439	1.7869	6.5533
n-hexane	5.6458	0.1129	4.6225	16.9531
Total CO2				1717.8022
CO2(e) from CH4[d,f]				252.6100

[a] Controlled and uncontrolled emission rates taken from 'GRI-GLYCalc Version 4.0 - Aggregate Calculations Report', attached. Note that these emissions occur at the flares associated with the dehydrator units.
[b] Carbon from Combustion (tpy) =[Uncontrolled Emission Rate (tpy) - Controlled Emission Rate (tpy)] * 12 (lb C / lb-mol C) * Number of Carbons in Constitutent / Molar Mass of Constituent (lb/lb-mol)
[c] CO2 Emissions = Carbon from Combustion (tpy) * Molar Mass of CO2 (lb/lb-mol) / Molar Mass of Carbon (lb/lb-mol)
[d] CO2(e) from CH4 = Controlled Methane Emission Rate (tpy) * 25 (CH4 GWP)

Fugitive (P801) GHG Calculation

Equipment type	Stream Type (Gas/Liquid etc)	Total Emissions (tpy)	CH4[d] Wt%	CO2(e) from CH4[e,f]
Connectors/Flanges	Natural Gas	0.2712	81.3%	5.5096
Connectors/Flanges	Light Oil	0.0383	0.49%	0.0047
Connectors/Flanges	Water/Light Oil	0.0010	0.49%	0.0001
Compressors	Natural Gas	0.5098	81.3%	10.3573
Open-Ended Lines	Natural Gas	0.1159	81.3%	2.3544
Pump Seals	Natural Gas	0.0000	81.3%	0.0000
Pump Seals	Light Oil	0.7532	0.49%	0.0930
Pump Seals	Water/Light Oil	0.0014	0.49%	0.0002
Valves	Natural Gas	3.1284	81.3%	63.5530
Valves	Light Oil	0.8672	0.49%	0.1071
Valves	Water/Light Oil	0.0341	0.49%	0.0042
CO2(e) from CH4				81.9837

[e] Taken from Gas Analysis and Condensate Analysis
[f] Global warming potential from 40 CFR 98, "2013 Revisions to the Greenhouse Gas Reporting Rule and Final Confidentiality Determination for New or Substantially Revised Data Elements". Table 2 - GHGs with Revised GWPs for Table A-1.
[g] CO2(e) from CH4 = Total Emissions (tpy) * CH4 Wt % * 25 (CH4 GWP)

Table A.13 - GHG Emissions from Heaters and Engines

Reboilers (B001 and B002) and Flare Pilots (P007 and P008)

			Emission Factors[a]			Emissions[b,c]		
Equipment	**Heat Input (LHV) (mmbtu/hr)**	**Heat Input (HHV) (mmbtu/hr)**	**CO2 (lb/mmbtu)**	**CH4 (lb/mmbtu)**	**N20 (lb/mmbtu)**	**CO2(e) CO2 Emission Rate (tpy)**	**CO2(e)** CH4 Emission Rate (tpy)**	**CO2(e)** N2O Emission Rate (tpy)**
Reboiler	2.5000	2.7500	116.9771	0.0022	0.0002	1408.99	0.66	0.79
Flare Pilot	0.0276	0.0304	116.9771	0.0022	0.0002	15.56	0.01	0.01

[a] 40 CFR 98 Subpart C, Tables C-1 and C-2 for Natural Gas and converted to lb/mmbtu

[b] Global warming potential from 40 CFR 98, "2013 Revisions to the Greenhouse Gas Reporting Rule and Final Confidentiality Determination for New or Substantially Revised Data Elements". Table 2 - GHGs with Revised GWPs for Table A-1.

[c] Emissions (tpy) = Emission Factor (lb/mmbtu) * Heat Input (mmbtu/hr) * 8760 (hrs/yr) / 2000 (lb/ton)

Engines (P001-P006)

					Emission Factors[d]			Emissions[e,f]		
Engine	**HP**	**Fuel Use (LHV) (btu/bhp-hr)**	**Fuel Use (HHV) (btu/bhp-hr)**	**Fuel Use (HHV) (mmbtu/yr)**	**CO2 (lb/mmbtu)**	**CH4 (lb/mmbtu)**	**N20 (lb/mmbtu)**	**CO2(e) CO2 Emission Rate (tpy)**	**CO2(e)** CH4 Emission Rate (tpy)**	**CO2(e)** N2O Emission Rate (tpy)**
CAT. G3612 TA	3,550	6629	7533	234261	116.9771	0.0022	0.0002	13701.60	6.46	7.70

[d] 40 CFR 98 Subpart C, Tables C-1 and C-2 for Natural Gas and converted to lb/mmbtu

[e] Global warming potential from 40 CFR 98, "2013 Revisions to the Greenhouse Gas Reporting Rule and Final Confidentiality Determination for New or Substantially Revised Data Elements". Table 2 - GHGs with Revised GWPs for Table A-1.

[f] Emissions (tpy) = Rated Horsepower (hp) * Fuel Use (btu/bhp-hr) * Emission Factor (lb/mmbtu) * Heat Input (mmbtu/hr) * 8760 (hrs/yr) / 2000 (lb/ton) / 1,000,000 (btu/mmbtu)

Table A.14 - Methanol Storage Tank Potential Emissions (T006)

EPA TANKS PROGRAM INPUT PARAMETERS

Tank Type	Horizontal		
Chemical Name Input	Methyl Alcohol		
Capacity	500	gallons	*Provided by Nathan Wheldon via email on 12/17/2012*
Net Throughput	182,500	gallons/yr	*Conservatively assumes one complete turnover per day*
Shell Length	6.98	ft	*Assumes the horizontal tank length is 2x the tank diameter*
Shell Diameter	3.49	ft	*Excel solver to determine diameter that gives a tank volume of 500 gallons*
Calculated Tank Volume	67	ft^3	*= pi x [diameter (ft)/2)]^2 x height (ft)*
Calculated Tank Volume	500	gallons	*= Calculated Tank Volume (ft^3) x 7.48 (gal/ft^3)*
Maximum Liquid Height	6.98	ft	*Maximum height of the tank*
Is the Tank Underground?	No		
Shell Characteristics	Defaults		
Nearest Major City	Akron, OH		

DIMENSIONAL ANALYSIS

Mass Conversion	2,000	lb/ton	*NIST SP1038*
Time Conversion	365	days/yr	
Time Conversion (July)	31	days/month	
Volume Conversion	7.48	gallons/ft^3	*NIST SP1038*

POTENTIAL EMISSIONS CALCULATION

Potential Methanol Storage Tank Emissions	***Calculated PTE***	***Units***	***PTE Description***
Maximum Monthly Loss	5.319	lbs/month	*Maximum VOC loss during any month*
Maximum Daily Loss	0.172	lbs/day	*= Maximum Monthly Loss (lb/month) / 31 days in July*
VOC Emissions	0.031	tpy	*= Maximum Daily Loss (lbs/day) x 365 (days/yr) / 2,000 (lb/ton)*

Table A.15 - Representative Inlet Gas Analysis

Inlet Gas Analysis

Sample Date: 1/14/2014 **Sample Of:** Gas

Station: Stutzman to Humphreys CS

Component	Mol %	Wt %	Wt% of TOC
Nitrogen	0.510%	0.801%	--
Methane	90.370%	81.260%	82.594%
Carbon Dioxide	0.330%	0.814%	--
Ethane	6.840%	11.528%	11.717%
Propane	1.250%	3.089%	3.140%
iso Butane	0.260%	0.847%	0.861%
n-Butane	0.230%	0.749%	0.761%
iso Pentane	0.080%	0.324%	0.329%
n-Pentane	0.050%	0.202%	0.206%
i-Hexanes	0.000%	0.000%	-
n-Hexane	0.080%	0.386%	0.393%
Benzene	-	-	-
Cyclohexane	-	-	-
i-Heptanes	-	-	-
n-Heptane	-	-	-
Toluene	-	-	-
i-Octanes	-	-	-
n-Octane	-	-	-
E-Benzene	-	-	-
Xylenes	-	-	-
i-Nonanes	-	-	-
n-Nonanes	-	-	-
i-Decanes	-	-	-
n-Decanes +	-	-	-
i-Undecanes	-	-	-
Total	100.00%	100.00%	100.000%
Total HC	99.16%	98.39%	
Total NMNE VOC	1.95%	5.60%	
Total HAPs	0.08%	0.39%	

Molecular Weight[a]	17.84	lb/lb-mol
Dry BTU @ 14.73 psia, 60 °F[b]	986.32	Btu/scf

[a] *∑Component Mole Fraction * Component Molecular Weight (lb/lb-mol*

[b] *∑Component Mole Fraction * Component Heat Content (btu/scf)*

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Humphreys 120 mmscfd
File Name:
Date: February 25, 2014

DESCRIPTION:

Description: Humphreys will have 2 identical 120 mmscfd dehydrators. This run represents each of the dehydrators.

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	2.3069	55.366	10.1044
Ethane	0.3464	8.313	1.5172
Propane	0.1045	2.508	0.4577
Isobutane	0.0322	0.773	0.1411
n-Butane	0.0323	0.774	0.1413
Isopentane	0.0140	0.335	0.0612
n-Pentane	0.0100	0.240	0.0439
n-Hexane	0.0258	0.619	0.1129
Total Emissions	2.8721	68.930	12.5796
Total Hydrocarbon Emissions	2.8721	68.930	12.5796
Total VOC Emissions	0.2187	5.250	0.9581
Total HAP Emissions	0.0258	0.619	0.1129

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	115.3468	2768.324	505.2191
Ethane	17.3195	415.669	75.8595
Propane	5.2250	125.399	22.8853
Isobutane	1.6109	38.661	7.0556
n-Butane	1.6132	38.717	7.0658
Isopentane	0.6983	16.760	3.0587
n-Pentane	0.5006	12.014	2.1926
n-Hexane	1.2890	30.936	5.6458
Total Emissions	143.6033	3446.479	628.9824
Total Hydrocarbon Emissions	143.6033	3446.479	628.9824
Total VOC Emissions	10.9369	262.487	47.9038
Total HAP Emissions	1.2890	30.936	5.6458

FLASH GAS EMISSIONS

Note: Flash Gas Emissions are zero with the Recycle/recompression control option.

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	12.4587	299.009	54.5692
Ethane	4.4695	107.268	19.5764
Propane	1.3799	33.117	6.0438
Isobutane	0.3928	9.427	1.7204
n-Butane	0.3780	9.072	1.6557
Isopentane	0.1330	3.192	0.5826
n-Pentane	0.0899	2.158	0.3938
n-Hexane	0.1535	3.684	0.6723
Total Emissions	19.4553	466.927	85.2142
Total Hydrocarbon Emissions	19.4553	466.927	85.2142
Total VOC Emissions	2.5271	60.650	11.0686
Total HAP Emissions	0.1535	3.684	0.6723

EQUIPMENT REPORTS:

COMBUSTION DEVICE

Ambient Temperature: 50.00 deg. F
Excess Oxygen: 0.00 %
Combustion Efficiency: 98.00 %
Supplemental Fuel Requirement: 7.24e-001 MM BTU/hr

Component	Emitted	Destroyed
Methane	2.00%	98.00%
Ethane	2.00%	98.00%
Propane	2.00%	98.00%
Isobutane	2.00%	98.00%
n-Butane	2.00%	98.00%
Isopentane	2.00%	98.00%
n-Pentane	2.00%	98.00%
n-Hexane	2.00%	98.00%

ABSORBER

NOTE: Because the Calculated Absorber Stages was below the minimum allowed, GRI-GLYCalc has set the number of Absorber Stages to 1.25 and has calculated a revised Dry Gas Dew Point.

Calculated Absorber Stages: 1.25
Calculated Dry Gas Dew Point: 3.44 lbs. H2O/MMSCF

Temperature: 90.0 deg. F
Pressure: 1100.0 psig
Dry Gas Flow Rate: 120.0000 MMSCF/day
Glycol Losses with Dry Gas: 1.6089 lb/hr
Wet Gas Water Content: Saturated
Calculated Wet Gas Water Content: 40.83 lbs. H2O/MMSCF

Calculated Lean Glycol Recirc. Ratio: 2.41 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	8.41%	91.59%
Carbon Dioxide	99.90%	0.10%
Nitrogen	99.99%	0.01%
Methane	99.99%	0.01%
Ethane	99.98%	0.02%
Propane	99.97%	0.03%
Isobutane	99.96%	0.04%
n-Butane	99.95%	0.05%
Isopentane	99.95%	0.05%
n-Pentane	99.94%	0.06%
n-Hexane	99.90%	0.10%

FLASH TANK

Flash Control: Recycle/recompression
Flash Temperature: 80.0 deg. F
Flash Pressure: 50.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.99%	0.01%
Carbon Dioxide	51.52%	48.48%
Nitrogen	5.27%	94.73%
Methane	5.66%	94.34%
Ethane	19.18%	80.82%
Propane	38.61%	61.39%
Isobutane	51.47%	48.53%
n-Butane	59.57%	40.43%
Isopentane	64.73%	35.27%
n-Pentane	70.71%	29.29%
n-Hexane	82.99%	17.01%

REGENERATOR

Regenerator Stripping Gas:
Dry Product Gas
Stripping Gas Flow Rate: 50.0000 scfm

Component	Remaining in Glycol	Distilled Overhead
Water	25.29%	74.71%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	0.77%	99.23%
n-Pentane	0.71%	99.29%
n-Hexane	0.60%	99.40%

STREAM REPORTS:

WET GAS STREAM

Temperature: 90.00 deg. F
Pressure: 1114.70 psia
Flow Rate: 5.00e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	8.60e-002	2.04e+002
Carbon Dioxide	3.30e-001	1.91e+003
Nitrogen	5.10e-001	1.88e+003
Methane	9.03e+001	1.91e+005
Ethane	6.83e+000	2.71e+004
Propane	1.25e+000	7.26e+003
Isobutane	2.60e-001	1.99e+003
n-Butane	2.30e-001	1.76e+003
Isopentane	7.99e-002	7.61e+002
n-Pentane	5.00e-002	4.75e+002
n-Hexane	7.99e-002	9.09e+002
Total Components	100.00	2.35e+005

DRY GAS STREAM

Temperature: 90.00 deg. F
Pressure: 1114.70 psia
Flow Rate: 5.00e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	7.24e-003	1.72e+001
Carbon Dioxide	3.30e-001	1.91e+003
Nitrogen	5.10e-001	1.88e+003
Methane	9.04e+001	1.91e+005
Ethane	6.84e+000	2.71e+004
Propane	1.25e+000	7.26e+003
Isobutane	2.60e-001	1.99e+003
n-Butane	2.30e-001	1.76e+003
Isopentane	8.00e-002	7.60e+002
n-Pentane	5.00e-002	4.75e+002
n-Hexane	7.99e-002	9.08e+002
Total Components	100.00	2.35e+005

LEAN GLYCOL STREAM

Temperature: 90.00 deg. F
Flow Rate: 7.50e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)

TEG	9.85e+001	4.16e+003
Water	1.50e+000	6.33e+001
Carbon Dioxide	4.48e-012	1.89e-010
Nitrogen	3.56e-013	1.50e-011
Methane	1.05e-017	4.44e-016
Ethane	6.18e-008	2.61e-006
Propane	2.17e-009	9.15e-008
Isobutane	5.75e-010	2.43e-008
n-Butane	5.49e-010	2.32e-008
Isopentane	4.47e-005	1.89e-003
n-Pentane	3.63e-005	1.53e-003
n-Hexane	1.07e-004	4.51e-003
Total Components	100.00	4.22e+003

RICH GLYCOL STREAM

Temperature: 90.00 deg. F
Pressure: 1114.70 psia
Flow Rate: 7.93e+000 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.38e+001	4.16e+003
Water	5.65e+000	2.51e+002
Carbon Dioxide	4.27e-002	1.89e+000
Nitrogen	3.39e-003	1.50e-001
Methane	2.98e-001	1.32e+001
Ethane	1.25e-001	5.53e+000
Propane	5.07e-002	2.25e+000
Isobutane	1.83e-002	8.09e-001
n-Butane	2.11e-002	9.35e-001
Isopentane	8.50e-003	3.77e-001
n-Pentane	6.92e-003	3.07e-001
n-Hexane	2.03e-002	9.02e-001
Total Components	100.00	4.43e+003

FLASH TANK OFF GAS STREAM

Temperature: 80.00 deg. F
Pressure: 64.70 psia
Flow Rate: 3.80e+002 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.02e-001	1.84e-002
Carbon Dioxide	2.08e+000	9.18e-001
Nitrogen	5.08e-001	1.42e-001
Methane	7.75e+001	1.25e+001
Ethane	1.48e+001	4.47e+000
Propane	3.12e+000	1.38e+000
Isobutane	6.75e-001	3.93e-001
n-Butane	6.49e-001	3.78e-001
Isopentane	1.84e-001	1.33e-001
n-Pentane	1.24e-001	8.99e-002

Component	Conc.	Loading
n-Hexane	1.78e-001	1.53e-001
Total Components	100.00	2.05e+001

FLASH TANK GLYCOL STREAM

Temperature: 80.00 deg. F
Flow Rate: 7.88e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.42e+001	4.16e+003
Water	5.67e+000	2.50e+002
Carbon Dioxide	2.21e-002	9.76e-001
Nitrogen	1.80e-004	7.93e-003
Methane	1.69e-002	7.47e-001
Ethane	2.40e-002	1.06e+000
Propane	1.97e-002	8.68e-001
Isobutane	9.44e-003	4.17e-001
n-Butane	1.26e-002	5.57e-001
Isopentane	5.53e-003	2.44e-001
n-Pentane	4.92e-003	2.17e-001
n-Hexane	1.70e-002	7.49e-001
Total Components	100.00	4.41e+003

FLASH GAS EMISSIONS

Control Method: Recycle/recompression
Control Efficiency: 100.00

Note: Flash Gas Emissions are zero with the Recycle/recompression control option.

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 7.00e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	5.63e+001	1.87e+002
Carbon Dioxide	2.61e-001	2.12e+000
Nitrogen	2.20e-001	1.14e+000
Methane	3.90e+001	1.15e+002
Ethane	3.12e+000	1.73e+001
Propane	6.42e-001	5.22e+000
Isobutane	1.50e-001	1.61e+000
n-Butane	1.50e-001	1.61e+000
Isopentane	5.25e-002	6.98e-001
n-Pentane	3.76e-002	5.01e-001
n-Hexane	8.11e-002	1.29e+000
Total Components	100.00	3.34e+002

COMBUSTION DEVICE OFF GAS STREAM

Temperature: 1000.00 deg. F
Pressure: 14.70 psia
Flow Rate: 6.05e+001 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Methane	9.02e+001	2.31e+000
Ethane	7.22e+000	3.46e-001
Propane	1.49e+000	1.04e-001
Isobutane	3.48e-001	3.22e-002
n-Butane	3.48e-001	3.23e-002
Isopentane	1.21e-001	1.40e-002
n-Pentane	8.70e-002	1.00e-002
n-Hexane	1.88e-001	2.58e-002
Total Components	100.00	2.87e+000

APPENDIX B

Modeling Files

The Ohio Gathering Company will deliver two (2) compact discs (CDs) each containing a complete set of modeling files under separate cover. For the purposes of this report, Appendix B includes a summary of the stack parameters used in this modeling analysis.

Table B-1. Summary of Point Source Parameters for Humphreys Compressor Station State-Level Modeling

Proposed Stack ID	Description	UTM East m	UTM North m	Elevation m	Stack Height[a] m	Stack Temperature[a] K	Exit Velocity[a] m/s	Stack Diameter[a] m	NO_X Emission Rate (lb/hr)
P001	Compressor Engine #1 - Caterpillar G3612	483882.6	4417271.2	377.04	16.42	1005.37	24.93	0.76	3.91
P002	Compressor Engine #2 - Caterpillar G3612	483884.9	4417253.2	377.04	16.42	1005.37	24.93	0.76	3.91
P003	Compressor Engine #3 - Caterpillar G3612	483887.2	4417235.1	377.04	16.42	1005.37	24.93	0.76	3.91
P004	Compressor Engine #4 - Caterpillar G3612	483889.9	4417216.8	377.04	16.42	1005.37	24.93	0.76	3.91
P005	Compressor Engine #5 - Caterpillar G3612	483892.6	4417199.0	377.04	16.42	1005.37	24.93	0.76	3.91
P006	Compressor Engine #6 - Caterpillar G3612	483895.1	4417180.8	377.04	16.42	1005.37	24.93	0.76	3.91
P009	Dehydrator Flare #1	483864.4	4417311.2	377.04	4.23	1273.00	20.00	0.47	0.48
P010	Dehydrator Flare #2	483864.5	4417310.5	377.04	4.23	1273.00	20.00	0.47	0.48
B001	Dehydrator Reboiler #1	483892.4	4417321.8	377.04	4.57	687.59	13.48	0.20	0.25
B002	Dehydrator Reboiler #2	483893.1	4417317.6	377.04	4.57	687.59	13.48	0.20	0.25

[a] Flares approximated as point sources in accordance with Ohio EPA Engineering Guide #69, Item 7.2. Stack parameters calculated as prescribed in Items 7.2.1) through 5).